A Post Trek Exploratory Study on

The Physical and Psychological Ill Health Effects

Of Trekking to Everest Base Camp Following Observations by the Author

Pamela Gellatly

Submitted in Partial Fulfilment of the Requirements for the Masters of Science Degree

In Exercise and Nutrition

October 2011

Word Count: 14,922

University of Chester

Parkgate Road

Chester CH1 4BJ

Abstract

Introduction: The purpose of this retrospective study was to understand and test the theory that multiple physical and psychological ill health effects occur when trekking at high altitude to Everest Base Camp (EBC), Nepal.

Method: The tour operator, The Adventure Company, agreed to send out 100 questionnaires to clients who had undertaken either the 11 day trek via Tengboche or the 16 day via Goyko Lakes, to EBC. The questionnaires also considered: age, gender, general levels of fitness and previous experience of trekking at altitude.

Results: The respondents (n=49) were 53% male (n = 26) and 45% female (n=22) and one unknown. Of the 49 participants, 36 lost weight ($p < 0.001$) sd $^{\pm}$ 2.95 of which 17 were males ($p < 0.001$) sd $^{\pm}$ 2.6 and 19 were females ($p < 0.001$) sd $^{\pm}$ 3.3. Altitude sickness was experienced by 38 trekkers or 78% ($p < 0.001$) using the Lake Louise Score for Acute Mountain Sickness (AMS); 35% (n=17) had mild AMS, 43% (n=21) had severe AMS. The incidence of other conditions was: bacterial infections = (n= 31) or 57% ($p < 0.001$); general heart rate (n=26) or 55% ($p<0.0001$); and 71% (n=35) heart rate at night ($p <0.0001$); low mood = (n=16) or 33% ($p< 0.001$).

Conclusion: The incidence of AMS was higher on reaching 4000m and was consistent with the literature. Other factors identified and consistent with the literature included: significant weight loss; bacterial infections; increase in heart rate in general and at night. Low mood was present during the trek and for some people continued on returning home and has not been well documented in other studies reviewed. Further research on the multiple ill health effects of trekking and how they may be prevented or better managed is needed to reduce risk and aid overall enjoyment.

FORMAT FOR DECLARATION

This work is original and has not been previously submitted in support of a Degree, qualification or other course.

Signed .....

Date .....……..

Acknowledgements

Thank you to Sean Hughes and Antony Barton of the Adventure Company for agreeing to circulate the questionnaire to customers who had recently participated in a trek to Everest Base Camp.

Thank you to all participants for taking the time to complete the questionnaire.

Thank you to Stephen Fallows from University of Chester for his supervision.

In Memory Of

Elisabeth Hildegard Lang born 6 Nov 1936 died 3 Nov 2001. On the trek to Everest Base Camp (EBC) Elisabeth felt unwell and decided not to continue. Her husband continued towards EBC with her encouragement. He then received news that she had died and he had to trek back as there was no other way to get back to her. Her body was taken to a hospital in Kathmandu by helicopter where it was identified that she had suffered heart failure. It is not known whether the altitude played a role in her death, whether she contracted anything else that placed a strain on her heart or whether the trek was too strenuous for her.

- Of all those climbers and trekkers who died living their dream in the Sagarmatha National Park. *May Sagarmatha and her neighbours look kindly on us as we continue to strive to achieve our personal goals in her garden.*

LIST OF TABLES

LIST OF BOXES

LIST OF FIGURES

1.0 The Physical and Psychological Ill Health Effects of Trekking to Everest Base Camp

1.1 Introduction

Trekking in Nepal is the ultimate location for travellers that seek adventure with eight of the fourteen of the highest mountains in the world, over 8000 metres, based in Nepal, including the world's highest, Sagarmatha or more commonly known as Mount Everest (Musa, Hall & Higham, 2010).

Since Tenzing Norgay (Sherpa) and Sir Edmund Hilary, as part of the British Expedition in 1953, succeeded in reaching the summit of Mount Everest, circa 3000 climbers have now successfully followed in their footsteps.

Over the last sixty years, the Everest region has not only been frequented by mountaineers, but more recently the routes have allowed the number of lowland dwellers seeking adventure at high altitudes to greatly increase (Karinen, Peltonen & Tikkanen, 2008). The trip to Everest Base Camp (EBC), via different routes is now offered by an increasing number of tour operators to what may be termed "altitude-naïve" trekkers. The ease of participating in such a trip and the natural lure towards this trek has also resulted in a significant increase in the average size of a trekking group (Gaillard, Dellasanta, Loutan & Kayser, 2004).

As more climbers achieve the still revered goal of summiting Everest, so more and more trekkers are setting their sights on what they deem personally achievable, in aiming to reach EBC at 5440 metres. The majority of trekkers now visiting the Sagarmatha (Everest) National Park are what are termed novices, suggesting not only that they are novice walkers, albeit that many may not have experience in walking for

6-8 hours per day, but that they are also likely to be inexperienced at walking at altitude as highlighted in Table 1.

Table 1: Self-rating of high altitude experience in Sagarmatha National Park

Self-rating of high altitude experience	Percentage
Novices	51.8%
Intermediates	35.9%
Experienced	12.3%

Ghazali Musa (2005)

The fascination with Nepal and the lure of high mountain adventure began to emerge in the mid 1970's (Musa, Hall & Higham, 2010). Altitude trekking in Nepal increased 330% between 1982 and 1994, and by 45% between 1994 and 2000. Trekkers and mountaineers account for 23% of all visitors to Nepal and are regarded as the most important market in economic terms (Musa, Hall & Higham, 2010). The number of tourists to the Sagarmatha National Park in October 2010 was the highest number recorded at 10,450 people.

The Sagarmatha (Everest) National Park (SNP) was established in 1976 and was declared a World Heritage Site in 1979 for its outstanding natural and cultural attributes. The altitudes within the park range from 2805m at the entrance to the park, to 8848m at the peak of Mount Sagarmatha and trekking holidays are available at a variety of altitudes. The greatest number of tourists (20.4%) to the SNP, are from the United Kingdom (Musa, Hall & Higham, 2010). The iconic EBC trek although labelled as a *strenuous* trek due to the high altitude, (5440m), is *marketed* to the regular hill walker, yet the potential health risks are not highlighted in tourism literature (Karinen, Peltonen & Tikkanen, 2008; Musa, Hall & Higham, 2010).

Data on the incidence of ill health, injury and death is sparse other than studies on Acute Mountain Sickness (AMS) or other serious altitude related problems Very few studies review the range of physical and psychological ill health risks, and what could or should be done to reduce the incidence and severity of such problems.

Tour operators have little knowledge of a person's fitness, experience at altitude, vulnerability to bacterial or respiratory infections, or any pre-existing ill health problems. As 88.9% of tourists visiting SNP experience one or more health ailments, health should be a major focus of sustainable tourism to the SNP (Musa, Hall & Higham, 2010) for the Nepalese Government and the private owners of the Tea Houses and Lodges.

From the outset the promotion of the 11 day trek to EBC within the standard 14 day holiday timetable means that the guides are under pressure to achieve the goal for their "clients" who have an expectation of success. As group sizes increase and age, gender and fitness of groups will vary, the recommended ascent rate and additional acclimatisation days may be difficult to achieve and may result in a higher incidence of ill health and death such as the case study in Box 1.

Box 1: Case Study

A 45 year old male with a history of bronchial asthma was travelling with an organised trekking group. They had flown in to an airstrip at 2800m (Lukla) and spent a few days in the local town before trekking to 5000m within 3 days. During this time he had complained of mild headache. The evening after arrival at 5000m, he complained of difficulty breathing but this was attributed to asthma and was told to rest. The next day, feeling better, he attempted to walk with the group up to a viewpoint about 100m higher (Kala Patar). He collapsed and was then put in a portable hyperbaric chamber for 20 minutes. After a brief period in the bag he struggled and complained of increasing dyspnoea. The group leader then decided to carry the victim in the bag down the mountain. After struggling for 6 hours, the group was exhausted and sent a runner to the nearest village to radio for a helicopter. The patient died soon after. A postmortem examination done a few days later confirmed the diagnosis of high altitude pulmonary edema. This case illustrates the importance of early diagnosis and aggressive management of this condition.

The purpose of this study was to identify the physical and psychological ill health effects of trekking at high altitude with specific focus on the 11 day (or 16 day) trek to Everest Base Camp in the Sagarmatha National Park (SNP), Nepal. The intent is for the data to be used to help provide more accurate information for "trekkers" to such destinations and to help tour operators address some of the associated and/or potential *health*, *wellbeing* and *safety* issues.

2.0 Literature Review and Study Rationale on the Physiological and Psychological Effects at Altitude

Much of the early research into high altitude sickness was devoted to life threatening problems of very high altitude climbers (Brundrett, 2004). More recent literature, over the last ten years, relating to activities at high altitude tends to focus on the incidence and severity of Acute Mountain Sickness (AMS) and the less common but more serious High-Altitude Cerebral Edema (HACE); High-Altitude Pulmonary Edema (HAPE) and High-Altitude Retinal Haemorrhage (HAR). Although all of these conditions can occur in trekkers, especially when trekking to altitudes as high as Everest Base Camp (EBC), the more serious HACE, HAPE and HAR are more commonly thought by the naïve trekker to be illnesses that occur in climbers rather than trekkers (Bezruchka, 2005; Farris, 2008).

This naivety of altitude related *illnesses* can lead to the onset of an illness that may have been prevented or better managed if the trekker had understood the risk factors and how to manage them when they occur. The following is a summary of the individual risk factors identified from the literature that specifically relates to trekking activities.

2.1 Personal Risk Factors for Altitude Related Illness

The actual altitude at which signs of ill health occur is very dependent on individual characteristics including: weight, age, gender and fitness. It is important that trekkers understand their own risk factors so that they may take additional precautions where necessary. A review of the most common individual risks identified in the literature are summarised below.

2.1.1 Weight

Overweight individuals tend to be more at risk of AMS than their slimmer counterparts. A study in a hypobaric chamber comparing two groups of subjects with large differences in BMI, found a significantly higher incidence of AMS in the overweight group, (Ri-Li, Chase, Witkowski, Wyrick, Stone, Levine & Babb, 2003) suggesting that being overweight *may* be an added risk factor at altitude.

2.1.2 Age

Trekkers over the age of 40 tend to have a lower incidence of AMS. It is thought that this is due to the fact that younger trekkers are more likely to trek *faster* than older trekkers and hence younger trekkers may not allow sufficient time for acclimatisation. In a 12 year follow up study by Gaillard, Dellasanta, Loutan & Kayser (2004) from 1986 to 1998, of 619 cohorts, (353 in 9186 & 266 in 1998), 45% of trekkers under the age of 25 suffered from AMS whilst the 26-35 age bracket had an incidence of 40%; the 46-55 age group had a lower incidence again at 30% and over 55 had an incidence less than 20%. The incidence of AMS in 1998 had dropped in all age groups which were thought to be due to a better understanding of altitude related illness

The younger trekkers may also *deny* or *ignore* the presence of any symptoms that may be related to altitude (Honigman, Theis, Koziol-McLain, Roach, Yip, Houston & Moore, 1993; Roach, Houston, Honigman, Nicholas, Yaron, Grissom, Alexander & Hultgren, 1995).

2.1.3 Gender

A study by Kayser (1991) found that the prevalence of AMS was higher in women (69%) compared with men (57%). Women also suffered more cerebral related AMS (49% compared to 39% in males) and a greater incidence of respiratory symptoms (64% compared to 53% in males). This study of 193 males and 160 women showed a higher overall incidence of AMS (63%) than the original study of trekkers to EBC by Hackett and Rennie (as cited by Kayser, 1992).

2.1.4 Attitude/Behaviour

Those who succumb to *peer pressure* or refuse to accept that the symptoms they are experiencing are likely to be altitude related, increase the difficulty of diagnosing the onset of symptoms of AMS and are at an increased risk of an altitude related illness (Farris, 2008).

2.1.5 Belief

Trekkers, who are altitude sensitive either physiologically or psychologically and take medication, are found to have a higher incidence of AMS. As the biopsychosocial aspect of medicine has identified over the last fifteen years, psychological factors such as attitudes, beliefs and fears can present as physical problems and cannot now be ignored when attempting to diagnose and treat what may appear to be a physical condition (Sullivan, Feuersteing, Gatchel, Linton, & Pransky, 2005; Waddell, Burton & Kendall, 2008).

2.1.6 Normal Residence at Sea Level

Low landers have a 3.5 odds ratio of experiencing AMS (Brundrett, 2004).

2.1.7 Dehydration

Insufficient water consumption is a common problem as trekkers fail to recognise water loss due to prolonged high breathing rate when ascending at altitude (Westerterp, 2001). Water requirement theoretically increases due to increased water loss at low ambient water vapour pressure. However in practice water loss at altitude is not higher than sea level. Therefore water loss at altitude is very much a function of intake (Westerterp, 1992).

2.1.8 Respiratory Problems

Anyone with a condition which affects breathing such as asthma or any lung condition has a 2.1 odds ratio of experiencing AMS (Basnyat, Combo & Edelman, 2000; Brundrett, 2004).

2.2 Physiological Adaptations to Altitude

In individuals who have not acclimatised, exposure to altitude hypoxia beyond 2000m to 2500m may lead to AMS (Gaillard, Dellasanta, Loutan & Kayser, 2004). Exercise inhibits altitude adaptation and therefore trekking at altitude is likely to increase the incidence of AMS. Exercise will also make existing AMS worse so continuing to trek once AMS symptoms have occurred is likely to increase the severity of AMS. Changes in atmospheric pressure and the impact this has on

physical and psychological factors, means that $2^1/_2$ hours of walking is more likely to feel like 8 hours of walking (Brundrett, 2004).

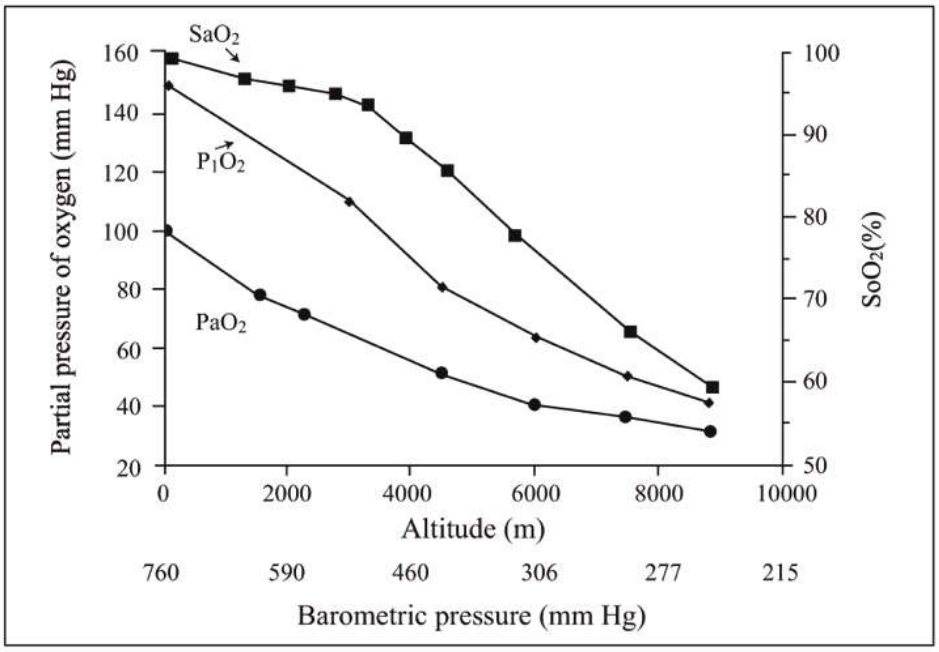


Figure 1: The relationship of altitude, barometric pressure and oxygen saturation.

As altitude increases and barometric pressure decreases inspired (P_1O_2) and arterial pressure of oxygen (Pao_2) including oxygen saturation (S ao_2) all decrease. Oxygen saturation is maintained until about 300m. Although it can occur earlier, this is the approximate altitude where AMS starts being more obvious with rapid ascents. With ascent, hyperventilation narrows the initial difference between P_1O_2 and Pao_2 to help maintain saturation of oxygen (Kim & Lee, 2007).

A summary of the body's response to altitude includes: heart rate increases; increased urination; blood vessels in the retina swell; blood flow in the eyes increase; reduced partial pressure of oxygen available cause blood saturation to diminish; constriction of the blood vessels within the lung occur with high pulmonary blood pressure; quick breathing and shortness of breath; taste discrimination; sensitivity to light; flatulence; fainting; effects of ultra violet radiation and psychological impairment (Brundrett, 2004).

2.2.1 Normal Physiology

Such physiological changes at altitude are well accepted and the most recognised are: hyperventilation/dyspnoea on exertion (no dyspnoea at rest); increased urination; waking many times during the night and periodic breathing (Hackett, 1995; Hutgren, 1997).

At altitudes over 2400m diagnosis of AMS is based on a headache plus at least one of the following symptoms: GI upset (loss of appetite, nausea and vomiting); fatigue/weakness; dizziness/light-headedness and insomnia which is more than just the usual frequent waking.

2.2.2 Breathing

As a trekker ascends there is an increased need to breathe more often but this varies from individual to individual. Forced vital capacity (FVC) can decrease by 3.7% and forced expiratory volume (FEV) in 1 second by 3.7% for every 1000m gained as observed in a study by Hashimoto, McWilliams and Qualis (1997). Medications, which may be taken for other reasons, such as sleeping pills, can reduce

the effectiveness of breathing adaptation and hence a trekker or indeed a guide may not realise that a medication is actually causing a problem. Conversely drugs such as Diamox (acetazolamide) can help substantially with breathing but as a diuretic, can then add to the other problems encountered.

Periodic breathing during sleep is a normal phenomenon often encountered at altitude and can be quite alarming for individuals who are not aware that this is one of the many changes that can occur. Apnoeic duration is commonly 3-10 seconds but may be as long as 15 seconds. Following acclimatisation this may reduce but is unlikely to resolve until after descent. With increasing altitude this may become more pronounced and may panic the trekker, especially if they wake during the breath holding phase or with the post apnoeic gasp when it is common to feel an acute shortness of breath. These changes to breathing are not related to altitude sickness (Hutgren, 1997: Farris, 2008).

Diamox, 125mg, taken about an hour before bedtime, reduces or eliminates periodic breathing and may be continued until the individual descends to a point, beyond where, the periodic breathing first occurred. Insomnia, which often occurs at altitude, is not considered connected with periodic breathing but is more likely to be associated with cerebral hypoxia (Hutgren, 1997: Farris, 2008). Acetazolamide can considerably improve sleep and hence lessen fatigue and possibly panic related problems.

2.2.3 Pulse Increase

Just as respiration increases whilst trekking higher then so does a person's resting pulse, especially during the first few days as the heart works to maintain the

oxygen flow. A trekker should take their pulse either first thing in the morning or at night whilst at rest. After a few days the pulse rate should drop indicating an adaptation to the altitude – if it does not then this is sign that a person is not adapting as quickly and should therefore consider slowing down the rate of ascent (Bezruchka, 2009).

2.2.4 Heart Rate

At altitude the body produces more red blood cells and this will cause a thickening of the blood. Many travellers who are not experienced in exercising at altitude are at risk of physical problems including cardiovascular disorders (Kanai, Nishihara, Shiga, Shimada & Saito, 2001). Changes in the autonomic nervous system control of the heart rate may reduce the heart rate variability as exposure to altitude increases. High and low frequency powers have significantly decreased ($p < 0.01$ for high frequency and $p < 0.05$ for low frequency) in office workers who ascend to 3700m (Kanai, Nishihara, Shiga, Shimada & Saito, 2001).

2.2.5 Urinary Response

The body experiences *diuresis* at altitude and especially when sleeping above 10,000 ft. (3050m). It is not uncommon to need to urinate 2 to 3 times during the night and to lose up to 2% of body weight from the extra urination. If this is not occurring then this may possibly be another sign that the body may not be adapting to the altitude and thus a person may be susceptible to altitude related illness (Bezruchka, 2005; Farris, 2008).

2.2.6 Blood Response

At altitude blood thickens, a process which may take a month or more. In the first few days of arrival at altitude, blood becomes thicker due to diuresis and associated fluid loss. After a time the blood will thicken as the body produces more blood cells to transport the oxygen required. Thick blood can clog more easily and may not be delivered as and when it is required (Farris, 2008; Bezruchka, 2009). Thus it is important to keep active even if the weather limits outdoor activities.

2.2.7 Changes during sleep

Most people will experience some difficulty in sleeping at altitude, sleep may be irregular and some people will wake up breathless at altitudes as low as 2440 metres. Sleep problems increase with ascent and are most common at altitudes of 4500 metres or above. Breathing can increase and become loud and in turn decrease and become quiet again. This is also symptomatic of periodic breathing and during its initial rapid phase when the body builds up oxygen in the brain, it may cause anxiety as the individual wakes up startled and does not understand what is happening. Trekkers who do not appreciate that this a normal experience can feel sufficiently concerned to abandon their trek. (Bezruchka, 2009; Farris, 2008; Jun & Polotsky, 2011).

2.2.8 Metabolic Rate and Body Composition

High altitude trekking can induce weight loss from a combination of decreased energy intake and changes in resting metabolic rate at altitude (Armellini, Zamboni, Robbi, Todesco, Bissoli, Mino, Angelini, Micciolo & Bosello, 2007; Manousou, Argiriadou, Illadis, Mavrovouniotis, Tsiligiroglou-Fachantidou, 2011).

There is evidence that the altitude limit for the maintenance of body weight is 5000m. Butterfield, Gates, Fleming, Brooks, Sutton and Reeves (1992) found that providing the amount of food was sufficient and palatable, weight loss could be maintained in extended stays of one month but the pathophysiology behind changes in body composition at extreme altitude is not understood.

2.2.9 Joints/Muscles

As altitude increases then there is less oxygen to help the exercising muscles. This may not only cause fatigue (Manousou, Argiriadou, Iliadis, Mavrovouniotis, & Tsiligiroglou-Fachantidou, 2011) but can place strain on joints. Hypoxia at altitude may also negatively interfere with the body's normal recovery process. Hoppeler, Vogt, Weibel and Fluck (2003) found that hypoxia influences mitochondria content and tissue oxidative capacity in muscle cells on a systemic level. On a molecular level, mitochondria are involved in hypoxia signalling, in which a number of other signalling pathways seem to co-operate but they did not reach an agreement on the mechanisms and their interplay responsible for the functional and structural modifications of skeletal muscle mitochondria in hypoxia.

A study by Lundby, Pilegaard, Anderson, van Hall, Sander & Calbet (2004) considered whether human muscle VEGF mRNA expression and capillary density would increase after 8 weeks of exposure to high altitude. Studies on animals had shown mixed results and studies on humans are rare. Their results showed that in the lowlands, haematocrit (Htc), haemoglobin (Hb) and arterial oxygen content (Cao_2) increased markedly during the first two weeks but did not increase any further in the next 6 weeks. Tests on high-altitude natives were not significantly different from those observed in the lowlanders. Body mass reduced initially by approximately 4 kg in the first two weeks but increased to an average loss of 1 kg below the sea level

average after 8 weeks. Mean fibre area was not significantly changed after 8 weeks and the fibre type distribution was also not affected by altitude. The capillaries fibre ratio also did not change significantly. They concluded that 8 weeks of exposure to 4100m did not induce any detectable angiogenesis in human skeletal muscle, neither did they find and change in muscle fibre type, distribution or mean muscle fibre area. The increase in haemoglobin concentration appeared sufficient to maintain adequate levels of oxygen supply and that angiogenesis is not necessary in order to preserve oxygen delivery to skeletal muscle.

2.2.10 Psychological Impairment

Assessment of simple functions at 3700m including: writing, reaction times, memory, and perseverance may be impaired. Brundrett (2004) noted that these were significant where there had been a rapid ascent to 3000m. Therefore the rapid ascent to Lukla (2800m) is likely to affect individuals from a psychological perspective but the changes may not be as noticeable as a physical condition such as shortness of breath, Basnyat, Cumbo & Edelman, 2000. McFarland (as cited by Brundrett, 2004) also noted a significant effect in the more complex tasks and reaction times were significantly longer when tested at 1500m.

Literature has shown that exposure to stressful stimuli such as cold and high altitude, increased physical activity and reduced oxygen, can increase stress hormone levels which in turn has been associated with negative mood states. How long this is likely to last on returning to normal living conditions is difficult to assess. Furthermore additional factors such as sleep deprivation and disruption of daily cycles could evoke additional stress signals independent of the environment.

Psychological ill health is rarely documented in altitude related research. One study on Marines, by Bardwell, Ensign and Mills (2005) which reviewed the impact of strenuous training at high altitude, found some surprising results. In general the Marines reported a better overall mood at baseline than the either college students or males from the general population. However, immediately after 30 days at altitude involving strenuous exercise, the reported levels of depression, anger, fatigue and total mood disturbance, exceeded the levels reported for these two normative groups. In addition the level of anger, vigour, and fatigue equalled normative values for male psychiatric patients and hence could be of clinical concern. BMI and body fat percentages decreased on average by 2% from baseline to the end of the exercise and 3% and 6% respectively 30 days post the exercise. The authors stated that they did not believe that it was the exercise alone that caused these changes and hypothesised that possibly food quality and quantity also added to the changes.

Marines are regarded as both physically and psychologically fitter than the average non-military person. The altitudes of this study in California are similar to those of the trek to EBC. Although the marines undertook a number of physical activities and carried a 45 kg backpack as opposed to 10-20kg daysack carried by most trekkers, it is possible that some of the findings of this study are relevant to the trekking population but are rarely measured. Bardwell et al., suggest that the low mood experienced by 30% of the Marines in this study may be associated with the combination of the environment and the physiological changes experienced together with the resulting weight loss. Musa, Hall and Higham (2010) also believe that psychological stress may contribute to AMS.

2.2.11 Diagnosis of Altitude or Non-Altitude Related Illness

The introduction of the Lake Louise (LLS) AMS score is believed by some researchers to overestimate the AMS incidence at moderate altitude. This may be due in part to the vagueness of questions such as dizziness or light headedness. These symptoms could equally be the result of insufficient energy intake relative to the amount of activity as it could be related to altitude. Roeggia, Roeggia, Podolsky, Wagner and Laggner (1996) concluded that the Hackett AMS score was the gold standard for evaluating AMS incidence, yet the LLS questionnaire is the one mostly widely used in the studies reviewed. With the increasing number of tourists to high altitude destinations and frequent human failure to disclose any problem, then the additional probability of AMS highlighted by the LLS may help increase awareness.

2.3 Major Risk Factors for Altitude Related Illness

The incidence and severity of altitude related illness is increased by five main risk factors:

2.3.1 Speed of Ascent

There are few problems with altitude if the rate of ascent is maintained at 300m per day (Basnyat, Lemaster & Litch 1999; Brundrett, 2004; Bezruchka, 2005). This allows the body to adapt and acclimatise. Reduction in pressure due to weather conditions can also increase the severity of an attack and oxygen saturation in the bloodstream tends to fall more with individuals who have other risk factors (Zafren & Honigman, 1997).

2.3.2 Time Spent at Altitude

The onset of an altitude related illness is normally between 6 and 24 hours after exposure. Although the higher the altitude the more likely an individual will be affected, for trekkers to moderate to high altitudes, increasing the time taken to reach the destination will support the acclimatisation process (Zafren & Honigman, 1997).

2.3.3 Altitude Reached

The higher the altitude the higher the risk of an altitude related illness. Very few problems are experienced below 1500m but onset in most people is around 3000m and practically everyone will experience symptoms at 4500m and above (Brundrett, 2004).

2.3.4 Sleeping at Altitude

Incidence is increased in trekkers sleeping above 2500m (Murdoch & Curry, 1998). Loss of sleep and disturbed sleep is likely to increase the incidence of headache (Brundrett, 2004).

2.3.5 Continued Exercise at Altitude

Exercise inhibits the altitude adaptation and therefore trekking will increase the risk of AMS and will make the presence of AMS worse if the exercise is continued. Hence this is one of the reasons why rest is recommended following the onset of symptoms (Brundrett, 2004).

2.4 Infectious Risks at High Altitude

Basnyat, Combo & Edelman, (2000) documented the pathogens encountered at high altitude as:

Box 2: Common types of infection at High Altitude

Gastrointestinal

Enteropathogenic bacteria, viral, protozoa, typhoid fever, hepatitis, parasitic infections, abdominal tuberculosis in local people.

Neurological

Rabies, Japanese encephalitis, bacterial meningitis.

Respiratory

Sinusitis, upper respiratory tract infection, bronchitis, pneumonia, influenza, tuberculosis.

Dermalogical

Pyoderma, furuncle, carbuncle, persistent wound infections, cellulitis, lymphangitis, herpes simplex, trauma/frostbite complications, scabies, lice, varicella, soft tissue and bone infections.

Urological

Sexually transmitted diseases, genital candidiasis, urinary tract infections.

Miscellaneous

Malaria, dengue, typhus, leptospirosis, dental caries.

The infections outlined in Box 2 are also found in lowland areas. It is the physiological changes that occur during acclimatisation that may modify normal defence systems against infections and T lymphocyte function is mildly reduced and therefore defence against bacterial infections compromised.

3.0 Health Problems Associated with Trekking at Altitude in the Sagarmatha National Park

3.1 Introduction

Altitude tends to be defined as: low altitude 7000 ft. (2130 metres) or below intermediate altitude extends to 12,000 ft. (3660 metres) whilst extreme altitude commences around 18,000 ft. (5490) metres (Bezruchka, 2009). Trekkers to Everest Base Camp (EBC) in the Sagarmatha (Everest) National Park are therefore trekking at the high intermediate level and are actually bordering on the extreme level. Many trekkers will have had little or no experience of trekking at this level and experienced trekkers will often recommend gaining experience at the lower intermediate levels of altitude prior to undertaking higher altitude treks such as EBC.

Trekking at altitude encompasses well known risks such as altitude related illnesses but the incidence and severity of altitude and non-altitude related ill health may be affected by the knowledge and experience of the trekker, the pace of the group, the experience of the guides, the accommodation, the food eaten and the weather.

3.2 Altitude Illness

Acute Mountain sickness (AMS) is stated to be the most common complaint amongst trekkers to the SNP (Table 2). Musa, Hall, and Higham, (2010) cited the report by Maundelexix (1992) and Murdoch (1997) that identified 67% and 84% of the trekkers surveyed, respectively, had symptoms (Table 3) of AMS. These findings concur with the admissions to the only hospital in the region at Kunde where 67% of admissions were for AMS. What individuals fail to understand is that AMS and the

other more serious altitude related illnesses, High-Altitude Cerebral Edema (HACE; High-Altitude Pulmonary Edema (HAPE) and High-Altitude Retinal Haemorrhage (HAR) are preventable in most instances by recognising the symptoms, acting on the findings and avoiding risky behaviour patterns.

Trekkers who fly into a high airstrip such as Lukla (2850m) have twice the incidence of AMS (Musa, Hall, & Higham 2010) as those trekkers that ascend more slowly and walk from Jiri (1900m).

Table 2: Altitude Illness in Trekkers to Everest Base Camp

Type	Incidence %	Altitude (m)	Symptoms	Treatment
AMS – Mild	50	3050	Hangover type	Don't raise sleeping altitude. Simple medication and acetazolamide.
AMS – Severe	2	4575	Difficulty co-ordinating	Descend immediately Hyperbaric bag, oxygen, acetazolamide, dexamethasone.
HAPE	1-2	4270	Extreme shortness of breath	Hyperbaric bag, Nifedipine, oxygen
HACE	0.05	4575	Poor co-ordination progressing to extreme lethargy and coma	Hyperbaric bag

Extract from Bezruchka, 2009

Denial of any symptoms, which may be related to altitude, is common. Headaches are sometimes regarded as sinus problems and trekkers do not seem to find it unusual that they have walked for 8 hours with a backpack often up and down hill, with a continuing increase in ascent, yet they somehow believe it is normal that they are not hungry. This denial is often accepted to be a feature of "*attitude illness"* (Farris, 2008).

Table 3: Symptoms and Signs of Altitude Illness

Symptom	Definition	Indicator of	Action
Headache	Pain in forehead or back of neck	AMS HACE	Painkillers, rest and re-evaluate in 12 hours. Look for other symptoms. Do not raise sleeping altitude.
Shortness of breath	Gasping for breath with little exertion	AMS HAPE	See if stops with rest. If not treat as HAPE.
Cough	From the chest which is on-going rather than a reaction due to say dust	HAPE Many other reasons	Very common at altitude and due to many causes besides altitude including: dry air, infections and many other problems. Needs further evaluation.
Extreme fatigue	Having more difficulty with the activity than others	Severe AMS HAPE HACE	Check breathing and if rapid at rest treat for HAPE. Check tandem walking and if poor treat for HACE. Do not raise sleeping altitude.
Ataxia	Lack of co-ordination (often determined by the tandem walking test)	Severe AMS HACE	Descend. Hyperbaric bag. Oxygen. Dexamethasone.
Altered mental state	An alteration in intellectual functioning, with emotional, attitudinal, psychological and personality aspect	Severe AMS HACE	Descend. Hyperbaric bag. Oxygen. Dexamethasone.
Diarrhoea	Loose and frequent bowel movements	Travellers' diarrhoea	Hydrate, antibiotic. Consider rest day.
Lack of appetite	Not feeling hungry or not wishing to eat as normal	AMS HAPE HACE Almost any other illness	Look for symptoms of other illnesses.
Feeling faint	Difficult to analyse but where an individual feels that they need to sit or lie down otherwise they may fall down and feel they may lose consciousness	Almost any condition	Checking ability to concentrate and do simple math. Check tandem walking. Give fluids if lightheaded. Consider a rest day.

Bezruchka, 2009

The rate of ascent is often one of the primary risk factors for AMS but the role of body hydration, age, gender, alcohol, medication, and altitude of sleeping all appear to play a part in the incidence. One study by Basnyat, Lemaster and Litch (1999) reviewed the incidence of AMS found in 550 trekkers in Pheriche (4234m). They found 29.8% of trekkers had AMS: low water intake, (OR 1.57. 95% CI, 1.02-2.40); respiratory symptoms, (OR 2.21, 95% CI 1.43-3.40); and oxygen saturation below 85%, (OR 2.35, 95% CI 1.55-3.56). In addition the risk of AMS decreased 18.7%, (95% CI 3.8-31.2%), for each additional night spent between Lukla (2804m) and Pheriche (4234m) thus providing indicators of the benefits of acclimatisation.

3.3 Heart Rate

A measurement of maximal heart rate (MHR) on five climbers revealed for two of the climbers that their peak HR's at 8750m were 142 and 144 bpm without the use of supplemental oxygen. This was similar (144 and 148 bpm respectively) to their maximal HR's at 5400m during an exhaustive exercise cycling test. Prior to acclimatisation during the initial trek to EBC, all five climbers had a mean maximal HR of 186 bpm (177-204) at sea level and 175 bpm (169-182) after acute hypoxia. After 1, 4 and 6 weeks acclimatisation prior to the Everest summit attempt, maximal HR's for the three other climbers were 155 (135-182), 161 (144-182), and 161 (140-183) bpm (Lundy & van Hall, 2004). This suggests a reduction in HR and maximal HR with increasing altitude as reported in research articles as early as 1937 by Christensen and Forbes (as cited by Lundy & Hall, 2004)

3.4 Nutrition in General

The tea houses/lodges tend to be quite expensive due to the cost of transporting food up the mountain (all food, water and fuel for cooking has to be

carried by porter). The local food is less expensive than any alternative food source but the food included in the "package price" may be somewhat restricted in quantity,

Although some trekkers maintain a relatively good appetite, the energy intake of most trekkers reduces well below both their normal daily intake and their norm when exercising. As a result of the lack of appetite, taste discrimination, and cost of food, energy intake could easily fall below 1500 calories per day. Trekkers choosing the European type menus are more likely to consume more calories (Manousou, Argiriadou, Iliadis, Mavrovouniotis & Tsiligiroglou-Fachantidou, 2011).

Nutrition at altitude is difficult due to the lack of fresh food and hence can cause a decrease in performance due to blood flow, most probably because of increased lipid peroxidation (Simon-Schnass, 1992). Supplementation with vitamin E has been shown to prevent such changes but more research is required to understand the implications of the lack of good nutrition.

Dehydration is a common cause of non-AMS related headaches. Trekkers, especially in the colder months, do not monitor how much fluid is being lost by sweat and breathing as well as the need to replace the fluids due to the amount of exercise, the altitude and the dry air. A study by Nerin, Palop, Montano, Ramon, Morandeira and Vazquez (2006) found that fluid intake was associated with, but insignificantly correlated with, the incidence and degree of AMS. However they felt that their study of military mountaineers was too small a sample size to demonstrate a statistically significant difference and believe that aggressive fluid intake is protective against AMS, as identified in their study and past research. An early study by Westerterp (2001) found that water loss was simply due to insufficient intake as opposed to any altitude related reason.

3.5 Nutrition for Endurance

Due to luggage restrictions on the flight to Lukla trekkers cannot travel with their normal energy "product" and opportunities to purchase such products is limited.

To maintain energy throughout the day individuals opt for biscuits and chocolate, hence consume relatively high Glycaemic Index (GI) food and which do not provide sustained energy.

3.6 Weight Loss

Individuals find that energy intake does not match energy requirements whilst trekking at altitude which means that considerable weight loss is not uncommon and trekkers lose weight in the form of fat mass as well as fat free mass.

Studies at around 6,500 m found a mean weight loss of 4.9 kg (± 2.1kg) over a 21 day stay in the area. The discrepancy between intake and expenditure was -150 MJ. The subjects did not maintain an energy balance despite a low level of exercise and ad libitum access to food. Energy intake measurements are usually based on a self-report as they were in this study with a tendency towards underreporting (Westerterp, 2001).

Trekkers to EBC are likely to experience an intake to expenditure discrepancy due to the availability of "comfort" foods, reduced satiety and the absence of energy dense food supplements (Westerterp, 2001).

3.7 Musculoskeletal Fatigue

Studies in the Himalayas have shown oxidative muscle metabolism to be shifted towards a higher reliance of carbohydrates as fuel, and intramyocellular lipid substrate stores are reduced. In addition lipofuscin has been found to accumulate which is believed to be a mitochondrial degradation product. Low mitochondrial contents are also observed in high-altitude dwellers such as Sherpa's. However their performance at altitude appears to be improved by a better coupling between ATP demand and supply pathways as well as a better metabolic homeostasis (Westerterp, 2001).

3.8 Risk of Bacterial Infections

A test conducted in springs at 5200m in 1978 demonstrated that the concentration of harmful organisms was three times the level recommended by the US Public Health Service for safe drinking. More than thirty years later as tourism to the area continues to increase, then the contamination of rivers and streams from human waste increases. This water is used for washing of vegetables, cooking and drinking and since the washing of hands for food preparation is not common practice, then it is easy to understand why bacterial problems are so prevalent (Basnyat, Cumbo & Edelman, 2000; Musa, Hall & Higham (2010).

The examination of water sources in SNP during the 1990's found that they were heavily contaminated with Coliform bacteria sufficient to produce illness (Pandey 1994; Ghazali Musa, 2002). Human waste is quite common in the Park and is attributed to the attitudes and behaviours of Sherpa's, Porters and Guides rather than the tourists. However the lack of a system for waste disposal, which leads to major effluent leaks into water sources and which is worse during the rainy season, unhygienic sanitary practices, ignorance of public health consequences and a low

literacy rate has resulted in many food borne diseases, such as diarrhoea and Hepatitis A, among others being endemic.

Diarrhoea is one of the most common ailments experienced by tourists in SNP (Musa, Hall, & Higham, 2010). This is mainly due to the problems associated with the sewage systems, unsafe water supply, even in large villages such as Namche Bazaar, and lack of knowledge by the local Nepalese people regarding proper hygiene and sanitation in food preparation, (Gasa, Musa, 2002). A strong indicator of the problems associated with waste and hygiene is that 95% of the population living in the Park in 1998 were Hepatitis A positive (Musa, Hall, & Higham, 2010).

As the altitude increases, there is no running water and any water used for the toilets is often frozen. Soiled toilet paper is left in open bins and with no hand washing facilities available, bacteria can spread quite easily. At the same time, at higher altitude, T lymphocyte function is mildly reduced and defence against bacterial infection may be compromised (Basnyat, Cumbo & Edelman, 2001). Exposure to ultraviolet light may influence changes to the immune system. Studies of granulocyte function during physical exercise at high altitude, describe rapid reversal of granulocytosis after initial extravasation and decreased production of superoxide anions. Hypoxia may also induce systemic increases in inflammatory markers and influence disease at high altitude.

Additional factors such as cramped sleeping conditions, general poor personal hygiene (washing) and concurrent illness and medications increase the gastric pH and promote the spread of enteric pathogens (Basnyat, Cumbo & Edelman, 2001).

3.9 Breathing

Hypoxia appears to play a key role in the pathogenesis of acute mountain sickness (AMS) as identified by Gaillard, Dellasanta, Loutan and Kayser (2004). A study in the Khumbu region of Nepal (the region around EBC) investigated the regional cerebral (rSO_2) and peripheral (SaO_2) oxygen saturation for the first time during a 22-day trek. Seventeen healthy volunteers between 19-65 years of age were examined and the results were that rSO_2 and SaO were significantly reduced at high altitudes of 4459m to 5050m. The decrease in cerebral saturation was more pronounced than the decrease in peripheral saturation at 5050m (rSO_2/SaO = 0.56) according to the study undertaken by Hadolt and Litscher (2003).

3.10 Respiratory Problems

When trekking at altitude, the exposure to dry air may injure the lining to the respiratory tract causing symptoms of coughing and respiratory infection (Wilkinson, Moore & Zafren, 2010). The dust on the trails in dry weather can further irritate the chest and throat. As altitude increases the cold increases, especially at night and the low pressure can increase the normal healing time.

In a study by Jafarian, Gorouhi, Gherherechi and Lotfi (2008) they found a relationship between the early signs of an increase in respiratory rate and the incidence of AMS. They found that a respiratory rate of over 20 bpm was a predisposing factor to severe AMS ($p < 0.001$). However, although the study focuses on respiratory rate it does not detail any other physical characteristics of the population that had the higher respiratory rate of 20 bpm and hence also had the higher incidence of AMS. It is possible therefore that other risk factors were present in the population studied.

3.11 Coughing

Coughing is experienced by 34.4% of tourists to the SNP and 66.7% of tourists suffered a respiratory problem during the peak season (Musa, Hall & Higham, 2010). Altitude cough may be due to bronchoconstriction (the narrowing of the airways that commonly occurs in asthma) or infections, but research has shown that the cough can occur without any evidence of infection or airway narrowing.

A cough could occur due to breathing cold, dry air on the mountains, but studies of cough in hypobaric chambers that controlled the ambient temperature and humidity, suggest that the receptors in the airways that provoke cough are actually more sensitive at altitude. Inflammation in the airways at high altitude may increase the receptor sensitivity, may be due to water loss from the respiratory tract, or be due to an infection, vasomotor rhinitis or may be due to fluid on the lungs (Wilkerson, Moore & Zafren, 2010).

Trekkers should be aware of any possible fluid in the lungs or other symptoms, which may represent the signs of High Altitude Pulmonary Edema (HAPE) in which case descent is necessary (Bezruchka, 2009; Wilkerson, Moore & Zafren, 2010).

Table 4: Documented Neurological, Visual, Pulmonary, and Miscellaneous Conditions at High Altitude outside the Setting of AMS, HAPE and HACE

Neurological Problems: Strokes and transient ischemic attacks, seizures, migraine, high altitude syncope, subarachnoid haemorrhage and transient global amnesia. Sudden symptomatic brain tumour.
Visual Problems: Retinal haemorrhage, lateral rectus palsy, radial keratotomy* causing long-sightedness, cortical blindness and amaurosis fugax.
Pulmonary Problems: Pulmonary embolism, respiratory tract infection and pneumonia
Miscellaneous Problems: Drug and alcohol related, hypothermia and dehydration, carbon monoxide poisoning, psychological problems, gastrointestinal and other infections, asthma and myocardial infarctions and language barrier

Basnyat, Cumbo and Edelman, 2000

*Please note that radial keratotomy is a surgical procedure for the correction of myopia but the information in the table has been quoted directly from the above authors.

3.12 Mood

Most publications on the effect of high altitude mention *lassitude* or a state of physical or psychological weariness, diminished energy or listlessness. The problem associated with mood is that it is sometimes difficult to know what occurs first. Is it the low mood that causes a person to feel tired as with many mental health conditions, or is it the physical tiredness, which causes the low mood?

The incidence of stress, anxiety and depression is on the increase, yet the impact of psychological responses to situations is often ignored and hence rarely assessed as a risk in the same manner that a physical risk would be assessed (HSE, 2000; Mental Health Foundation, 2009).

A person's mood can be affected by the physiological changes in the body but in addition their mood will be influenced by the environmental conditions. Conditions that may affect an individual and their normal coping mechanisms include: walking up hill at altitude; weather conditions, hot and cold; sleeping conditions and comfort. In addition, fears, attitudes and beliefs and emotions may be affected by the enormity of the experience including the height of the mountains and the people and how they live. This may affect behaviour and present as low mood or conversely "gung-ho" type conduct. Either way it is possible that their psychological health may be affected or may go unnoticed. Buddha Basnyat personally witnessed violent behaviour in two individuals whilst trekking in the Sagarmatha National Park, which disappeared as soon as the individuals returned to their home environment (Basnyat, Cumbo & Edelman, 2000).

3.13 Temperature

During the day the temperature can rise to over 20 degrees centigrade, at moderate altitude in SNP, and at the higher elevations more exposure to UV radiation increases the risk of sunburn. At night and early morning, temperatures can drop to minus 15-20 degrees centigrade, and unless wearing the correct clothing and using the appropriate equipment, this can expose the trekker to hypothermia (Farris, 2008). Comfort levels in the tea houses, is sufficiently low enough to force most trekkers to sleep fully clothed, with sleeping bags and blankets thus adding to the difficulties in sleeping.

3.14 Water/Hydration

Bottled water is expensive in the SNP (due to it having to be carried up the mountain by porters) which encourages trekkers to use tap or stream water. Although

most trekkers would treat such water, they may not allow enough time for the treatment to kill the bacteria, may not have a product which treats all bacteria and may find the taste not conducive to drinking sufficient quantity. Maintaining good hydration is recognised to be an independent risk factor in the prevention of AMS (Basnyat, Lemaster & Litch, 1999; Nerin, Palop, Montano, Ramon, Morandeira & Vazquez, 2010).

3.15 Carbon Monoxide Poisoning

In the evening the only form of heat in the tea houses is from a wood burning stove normally in the centre of the dining area. The fumes from these stoves can cause headaches and nausea but as they tend to only be lit for a relatively short period and are fuelled mostly with dried yak pats, carbon monoxide poisoning is rare (Basnyat, Cumbo & Edelman, 2000).

3.16 Other Infections

Dengue fever, meningitis, Japanese encephalitis, cerebral malaria, typhoid fever and staphylococcal sepsis are also found in Nepal (Centre for Disease Control and Prevention, 1999-2000).

3.17 Use of Medication

Gaillard, Dellasanta, Loutan and Kayser (2004) in a 12 year follow up on awareness, prevalence, medication use and risk factors of AMS in Nepal found a significant increase in the use of medication as detailed in Table 5.

Table 5: Change in Medication Use 1986 to 1998

Medication	1986	1998	Significance
No Medication	83%	44%	$p < 0.001$
Use of analgesics	15%	46%	$p < 0.001$
Use of Acetazolamide	1%	12%	$p < 0.001$

Although they found an overall decrease in the incidence of AMS from 43% in 1986 to 29% in 1998 they believed that this was due to a number of factors including: increased awareness of AMS from 80% to 95%; an opportunity to acclimatise more slowly due to better lodges; an older age profile and a slower ascent rate combined with the use of more medication including acetazolamide.

The use of inappropriate medication at altitude is a potential health hazard. The authors observation of the guides carrying and dispensing a large supply of medication, suggests that a considerable number of trekkers are not prepared for incidence and severity of the symptoms and health ailments that occur.

The study by Kilner and Mukerji (2010) undertaken within the Everest region in Nepal, also considered the high proportion of travellers who used *acetazolamide* (Diamox). The purpose was to identify the appropriate dose sufficient to prevent high altitude illness and to identify, assess and understand the factors that affect AMS prophylaxis use. This study was based on a qualitative component of 20 one-to-one interviews and a quantitative component which used a questionnaire to 50 guides and 300 trekkers.

The results were that guides had a poor understanding of prophylactic medication and hence these findings support the observations of the author. Of the 300 trekkers, 25% took acetazolamide of which, only 3.3% took the acetazolamide one to two days before high altitude. Poor knowledge amongst trekkers and guides was the main reason behind such poor uptake and inappropriate usage. Kilner and Mukerji (2010) concluded that trekker-targeted interventions are required to reduce morbidity and mortality. Tour companies in Nepal and tour operators should risk assess the training, in the *field* diagnostic procedures of the guides, and the frequency and type of medication being dispensed.

An earlier study by Basnyat, Gertsch, Johnson, Castro-Marin, Inque and Yeh (2003) found that low-dose acetazolamide (125mg BID) taken twice daily could significantly reduce the risk of AMS. They conducted a study with 197 healthy male and female trekkers of diverse backgrounds using the Lake Louise Acute Mountain Sickness Scoring System between Pheriche (4243m) and with Lobuje (4937m) as the end point. The treatment group had an incidence rate of 7 out of 74 compared with 20 out of 80 in the placebo group. The prophylaxis with acetazolamide conferred a 50.6% relative risk reduction. In addition 30% of the placebo group versus 0% in the treatment group experienced more severe AMS symptoms. Furthermore the treatment group also experienced a decrease in headaches and a greater increase in final oxygen saturation at Lobuje. Thus, Basnyat et al. concluded that this low-dose taken twice daily of acetazolamide was effective in reducing the incidence of AMS.

3.18 Summary of Health Ailments in the Everest Region

In the survey conducted by Musa, Hall and Higham (2010) they reported that 88.9% of tourists visiting SNP experienced one or more health ailments as detailed in Table 6.

Table 6: Health ailments experienced whilst visiting Sagarmatha National Park

Symptoms	Percentage	Comments
1. Headache	61.0	Sign of AMS – normally treated with paracetamol
2. Shortness of breath	49.1	Sign of AMS
3. Muscle strain/pain	42.3	May be due to insufficient or inappropriate training prior to the trek. May also be due to a muscular imbalance, which could be corrected by appropriate exercise.
4. Fatigue	37.8	Sign of AMS Could also be associated with the numbers of hours walking and lack of sleep.
5. Cough	37.4	Potentially due to lack of moisture in the air and the dusty trails. May also be due to an infection such as a cold or flu. Can be treated with a cough medicine. However trekkers should also be aware of more serious problems such as HAPE
6. Diarrhoea	37.2	80% of cases are due to a bacterial infection and should be treated as such with antibiotics; hydration and electrolyte replacement drink; and bowel immobiliser (e.g. Imodium).
7. Insomnia	36.7	Sign of AMS
8. Loss of appetite	33.8	Sign of AMS

9. Stomach discomfort	31.5	Could be due to flatulence, a common altitude problem; water retention - again another common problem or a sign of a bacterial infection. Trekkers tend to take medication for bacterial problems but not other stomach disorders and local options once on the trek are limited and not as effective.
10. Sore throat	24.5	Could be due to the atmosphere and the dusty walking trails. May be a throat infection. Easily treated with throat lozenges.
11. Joint pain	21.7	A number of individuals may take ibuprofen type products in tablet or cream form if they anticipate a problem. Sometimes such problems can occur due to the lack of appropriate training but many problems can be addressed by medication and heat. Occasionally a group may be lucky enough to have a physiotherapist or sports massage therapist as part of the group.
12. Sunburn	16.9	A preventable problem with good high factor sun cream preferably one which is designed for high altitude and for sports activity due to sweating as this is likely to remove normal sunscreen.
13. Backache	15.5	A very common condition in general and this is consistent with the number of people who report back pain at any point in time. Often backache is due to muscular imbalance, which can be addressed with corrective exercise. Again many people with problems will take medication and heat patches with them. Again this can also be due to insufficient or inappropriate exercise prior to the trek.

14. Dizziness	15.3	Sign of AMS This could also be due to lack of food, low blood sugar levels or low blood pressure. Rest, eating low to moderate carbohydrates if possible with a non-fizzy drink which will help identify whether this is altitude related.
15. Vomiting	14.9	Sign of AMS. Could also be associated with a bacterial infection – in which case this tends to dissipate within 24 hours.
16. Blisters	14.6	These are avoidable with good fitting boots and socks as well as good foot hygiene. However, trekkers should always carry special blister plasters.
17. Respiratory Infection	10.8	This could be associated with a cold. Depending on severity, may be treated with paracetamol and if more severe then antibiotics. However care again should be taken that this is not something more severe such as HAPE especially if associated with what sounds like fluid on the lungs.
18. Fever	9.7	This could be associated with an infection.
19. Shortness of breath at rest	9.2	Sign of AMS
20. Cuts/bruises	7.0	As tiredness increases then individuals are more likely to slip and trip
21. Loss of balance	6.1	Sign of AMS
22. Confusion	2.5	Sign of AMS

23. Hypothermia	2.5	For trekkers this should be preventable but the stage of hypothermia will dictate the treatment. Warming of the person with insulation clothing, a blanket etc. is the immediate method and not rubbing the person or immersion in warm water.

First two columns Musa (2005) (n = 448). Symptoms in bold are signs of AMS

Musa, Hall and Higham (2010) also asked their participants what they felt were the worst aspects of their trekking experience as outlined in Table 7.

Table 7: Worst aspects of tourists' experience of SNP

Worst Aspect	Percentage
1. Getting sick	28.0
2. Toilets	26.0
3. Rubbish/litter	17.0
4. Too many people	12.2
5. Cold	11.2
6. Rain	10.4
7. Dirty/poor/muddy trails	9.7
8. Unhygienic practices/poor sanitation	9.2
9. Food	8.4

Musa (2005)

If you combine the 26% of tourists who found the toilets to be the worst aspect with the 9.2% that found the unhygienic practices/poor sanitation their worst experience, then this equates to 35.2% and is consistent with the percentage of tourists who experienced a bacterial infection.

Nepal is one of the countries with the highest risk of gastrointestinal illness in the world. Yet, in the author's experience, the trekking guides often refused to accept that diarrhoea and vomiting are potentially bacterial problems.

This may be due to language difficulties which complicate the understanding and interpreting of symptoms. (Basnyat, Combo & Edelman, 2000) and combined with a lack of knowledge of the individual means making a diagnosis is even more complex. The standard advice is that if in doubt, then treat as an altitude problem. Most cases (80%) of diarrhoea in travellers when trekking in Nepal are due to bacterial infections as reported by the CIWEC Travel Medicine clinic in Kathmandu. Antibiotic medication, rehydration treatment and bowel immobilisers such as Imodium can alleviate the problem fairly quickly but if not then it is possible that a half to full day's trekking could easily be lost, placing further pressure on the pace of the trek and possibly missing crucial acclimatisation.

A further 11% of cases are due to Giardia, a parasite that causes relatively low grade, chronic diarrhoea associated with stomach rumbling, gas, abdominal cramping and 3-5 loose stools per day. After this the causes of diarrhoea are either rare or related to another underlying illness not related to the tourist activity.

The CIWEC state that it must be assumed that all water in Nepal is contaminated and that bottled water should be used or that boiled and filtered (treated) water may be used. This advice certainly does not appear to be followed by the tea houses/lodges or by the trekking guides. One of the local "cures" for AMS includes taking a flask of boiling water to bed. The CIWEC state that even boiled water should be treated. The CIWEC also state that even though hotel and restaurant water claims to be boiled, this may not be so. The trekker should not expect the water in tea houses

to be treated or boiled correctly due to the cost of fuel and the lack of understanding of the problems contaminated water can cause, especially to tourists.

Of all the diseases frequently experienced by tourists to the SNP, nine out of ten are preventable (Musa, Hall & Higham, 2010). Education of trekkers, tour operators and locals should be more commonplace. Trekkers should be made aware of the broader potential health problems and how to avoid them or at least reduce the risk of ill health or to mitigate the impact any such illness may have.

Even though most tourists are arranging their trip to SNP via travel agents and trekking agents, only 17.2% and 10.5% respectively of these organisations provide health information (Musa, 2005) and even then the information provided is very basic.

Table 8: Summary of the Main Articles Reviewed Specific to Trekking in the Himalayas, Nepal

Author, Year	Subject and Size of Study	Main Findings
Kayser, 1991	AMS n=353	Annapurna at altitude of 5400m maximum. The study consisted of a pre-trek questionnaire the evening before followed by a questionnaire completed over the 8 day trek. The prevalence of AMS was 63%. AMS with a cerebral complex (AMS-C) was 43% and with a respiratory complex (AMS-R) 57%. Incidence of AMS was associated with rate of ascent ($p < 0.02$) and less cumulative altitude ($p < 0.005$). The prevalence for women was 69% compared with men at 57% ($p < 0.05$) and women had greater scores for both AMS-C and AMS-R. Age was negatively correlated with speed of ascent ($p < 0.05$) and positively with BMI ($p < 0.05$). Males with AMS had significantly higher BMI $p < 0.005$)
Basnyat, Lemaster, Litch, 1999	AMS, n = 550	Everest region from trekkers over 1 month from Lukla (2800m) to 4234m (Pheriche). AMS diagnosed in 29.8% using LLS. Increased risk of AMS from low water intake (OR 1.57, 95% CI, 1.02-2.40); the presence of respiratory symptoms (OR, 2.21, 95% CI. 1.43-3.40) and oxygen saturation below 85% (OR, 2.35, 95% CI, 3.8-31.2%).

Basnyat, Cumbo, & Edelman, 2000	Acute Medical Problems 1st Published review	Everest Region documenting neurological, visual, pulmonary and miscellaneous conditions outside of AMS, HAPE or HACE. See Table 4.
Basnyat, Subedi, Sieggs, Lemaster, Basnyat, Aryai, & Subedi. 2000	AMS, HAPE & HACE N=228	Gosainkund at 4300m study of pilgrims to a sacred lake found 68% had AMS, 31% had HACE and 5% had HAPE. The mean oxygen saturation was 77%, the norm being 87% for 4300m. Women had a significantly higher rate of AMS (OR 4.34, 95% CI 1.83-10.88) and HACE (OR 3.15, 95% CI, 1.62-6.12) and HAPE (OR 5.2, 95% CI, 1.24-24.73).
Basnyat, Combo & Edelman, 2001	Infections	Another review of the types of infection occurring at high altitude including: Gastrointestinal; Hepatitis A and E; Neurological; Respiratory; Dermatological; Insect Borne and other infections.
Basnyat, Gertsch, Johnson, Castro-Marin, Inque and Yeh, 2003	Efficacy of low-dose acetazolamide N – 155	Prospective randomized double-blind placebo controlled trial using LLS as measured at Lobuje (4937m). Key findings were acetazolamide 125mg twice daily was statistically effective in halving the incidence of AMS; decreasing the incidence of high altitude headache and improving oxygenation.

Hopperler, Vogt, Weibel & Fluck, 2003	Skeletal muscle mitochondria response to hypoxia	Review of studies based on mountaineers returning from the Himalayas. On a systemic level hypoxia influences mitochondria content and tissue oxidative capacity in skeletal muscle cells. On a molecular level mitochondria are involved in hypoxia signalling, but no agreement reached on the mechanisms and their interplay responsible for structural and functional modifications.
Basnyat, Wu & Gertsch, 2004	Neurological conditions outside AMS	Similar to review in 2000 but specific to neurological symptoms.
Gaillard, Dellasanta, Loutan & Kayser, 2004	Awareness, Prevalence, Medication and Risk factors of trekking N = 353 in 1986 and 266 in 1998	Annapurna region of Nepal and 12 year follow up. Experience at altitude had increased 48% compared to 30% ($p < 0.0001$). Significant increase in group size ($p < 0.01$). Awareness had increased $p < 0.001$). AMS had decreased 43% to 29% ($p < 0.0001$). Use of acetazolamide had increased ($p < 0.001$). Time at altitude slightly less but acclimatisation at the higher altitude slightly longer. Young people still higher risk of AMS. Women slightly greater risk. Climbing profile of more than 350m per day greater risk.
Major & Doucet, 2004	Energy Intake N = 7	Very small study on a 19 day trek to Makalu Base Camp. Body weight was significantly reduced ($p < 0.01$); a total decrease in EI ($p < 0.05$) and an increase in EI on return to low altitude ($p < 0.001$).
Lundy & van Hall, 2004	Heart Rate N = 5	Another very small study. Max mean HR at sea level was 186 and 170 with acute hypoxia. After 1, 4 and 6 weeks of acclimatisation to 5400m max HR were 155, 158 and 161 bpm respectively. Two individual then summited Mount Everest (8750m) and their max HR were 142 and 144 bpm.

Vardy, Vardy & Judge, 2006	AMS and Ascent Rates N = 150	Khumbu region. AMS assessed at various altitudes using the LLS. The incidence of AMS varied considerably from 0% in the 2500m-3000m altitude; 10% at 3000,-3500m; 15% at 3500m-4000m; 51% at 4500m-5000m and 34% at over 5000m. Correlation as expected between altitude and AMS ($p < 0.001$). Incidence HAPE 0.7%. The mean vertical ascent rate was 287m in 24 hours, 500m in the preceding 48 hours and 751m in the last 72 hours. Those that had AMS had ascended at a mean rate of 844 m compared with a mean of 722m over 72 hours of those trekkers who did not have AMS. The mean range of ascent of those who suffered AMS was within the recommended guidelines.
Edwards et al, 2010	Skeletal muscle N=14	Everest region. Altitude naïve trekkers. Found that although there was significant muscle atrophy ($p < 0.05$) skeletal muscle function was maintained.
Kilner & Mukerji, 2010	AMS and knowledge and behaviours	Everest region. Comprised 20 x 1 to 1 interviews plus 300 questionnaires to trekkers and 50 to guides. Results were guides had a poor knowledge of medication. 25% of trekkers used acetazolamide. Poor knowledge of trekkers and guides resulted in inappropriate prophylaxis medication and reduced trekkers, morbidity and mortality.
Musa, Hall & Higham, 2010	Tourism sustainability and health impacts	A study of 448 trekkers to the Sagarmatha National Park found 88.9% of tourists to the Park suffered one or more health ailments of which the most common were associated with altitude. However muscle strain/sprain was the 3rd highest incidence at 42% with cough (37%) and diarrhoea (37%) being the next most common and which were thought to be unrelated to AMS. See table 6.

4.0 Aims and Objectives of this study

As outlined in the previous chapters, the number of lowland dwellers seeking adventure at high altitudes has greatly increased in recent decades and is offered by an increasing number of tour operators to what may be termed "altitude-naïve" and relatively inexperienced trekkers (Karinen, Peltonen & Tikkanen, 2008).

The focus of studies relating to trekking at moderate to high altitudes have focused on the prevalence of Acute Mountain Sickness (AMS) or more serious altitude related problems. Few studies consider the range of physical and psychological ill health conditions experienced and how these may be avoided or better managed.

The aim of this study was to identify the incidence and severity of a range of both physical and psychological ill health problems including both altitude and non-altitude related illnesses when trekking at moderate to high altitudes.

The information gained from this retrospective study on the illnesses suffered and the individual variances of the population including: age, gender, weight, previous experience of trekking at altitude, levels of fitness and previous experience of endurance activities, should help identify whether individuals can prevent or better manage these illnesses and improve the overall enjoyment of trekking at altitude.

The objective is to use the findings to help trekkers and tour operators understand the wide range of ill health problems that can occur, why and when they occur and what can be done to prevent and manage such illnesses.

From a *Health, Wellbeing* and *Safety* perspective, the study aims to understand the risk factors and what, if any can be eliminated or reduced without affecting the overall enjoyment or challenge and thus without destroying the *real essence* of why people undertake such activities.

As more and more tourists choose to participate in trekking as an activity based holiday, often to help improve their health and wellbeing, then it is important to reduce any unnecessary risks which will inevitably arise as a consequence.

Awareness of the problems associated with trekking at altitude has improved over the last twenty years but as more and more naïve trekkers visit such locations then it is important that the tourist industry and the local government actively support tourists with *knowledge* of the risks and how to avoid or reduce the severity of them.

The information may then be used to assess whether further studies should be conducted to help trekkers, tour operators and governments in high-altitude destinations to decide how ill health risks may be prevented, better managed or mitigated for the tourist and for the local people residing along the trekking routes

5.0 Methodology

The author trekked to EBC in November 2010 and observed a number of physical and psychological ill health effects across various people including: fellow trekkers known to the author; other trekkers with the Adventure Company who undertook the trek at the same and various trekkers spoken to en-route or in the tea houses in the evening.

Consideration was given as to whether a prospective study should be undertaken with guides also observing the participants. However to organise such a study would have taken considerably longer to undertake and would have incurred additional cost. A decision was therefore taken to submit a proposal for an exploratory study which was retrospective and would be based on individuals who had trekked to EBC from November 2010 to April 2011.

Consent to this study was given by the Ethics Committee at the University of Chester (FREC reference, 503/11/PG/CS: Appendix 4) to gain a better understanding of the ill health risks of trekking to high altitude locations such as Everest Base Camp (EBC). The Adventure Company (part of TUI Travel plc.) volunteered to participate by circulating the questionnaire to their customers, to help them understand how the information may be used to help reduce ill health risks to trekkers and indicate what more they should consider as a tour operator.

A letter of invitation and a participant's information sheet was sent with a self-administered questionnaire, specifically designed for this purpose, to 100 individuals who had trekked to Everest Base Camp with the Adventure Company in the previous 6 months. The Adventure Company selected individuals randomly from trekkers who

had participated in trips to Everest Base Camp and included those trekking during two of the busiest periods in Nepal, namely, November and April.

The questionnaire was aimed at trekkers who had participated in the 11 day trek to EBC but the Adventure Company also sent the questionnaire to some individuals who had participated in the 16 day trek to EBC via Goyko Lakes and the Cho La Pass. Although the route via Goyko Lakes and the Cho La Pass was longer, and the exposure to altitude was greater, which could reduce the incidence of AMS due to acclimatisation, it was decided that these questionnaires would be included.

Although a total of 51 questionnaires were received only 49 were analysed as the last 2 questionnaires arrived after the data had been collated.

The literature reviewed in chapter 2 and 3 provide the *rationale* behind the questions in the questionnaire, an example of which is attached in Appendix 2. The intent was that demographic information about the individuals participating in the trek including: age; gender; height; and weight would provide a profile of the trekkers. General levels of fitness and exercise taken prior to trip, together with experience of trekking at altitude, and details of any specific training prior to the trek would indicate how well people prepared for such an adventure. Information on the physiological and psychological effects of the trek including: weight loss; altitude sickness; heart rate; bacterial infections; mood; other ill health symptoms and what medication was taken, would identify the incidence and severity of problems suffered during the trip and whether any further research is justified. Finally a summary of the worst and best aspects of the trek would indicate whether more should be done to help future trekkers to prevent and manage ill health and injury.

The effects of altitude sickness were identified using the Lake Louise Score (LLS) for the diagnosis of Acute Mountain Sickness (AMS). This clinical worksheet and scoring mechanism (Appendix 3) was developed in 1991 by the International Hypoxia Symposium held at Lake Louise in Alberta, Canada, and is widely used today to assess the severity of illness (Sutton, Coates, & Houston, 1992).

The LLS scoring mechanism is based on the following definitions:

Box 3: The Symptoms Used in the Lake Louise AMS Assessment Tool for the Identification of AMS, HACE and HAPE

AMS

In the setting of a recent gain in altitude, the presence of headache and at least one of the following symptoms:

- gastrointestinal (anorexia, nausea or vomiting)
- fatigue or weakness
- dizziness or light headedness
- difficulty sleeping

HACE

Can be considered "end stage" or severe AMS. In the setting of a recent gain in altitude, either:

- the presence of a change in mental status and/or ataxia in a person with AMS
- or, the presence of both mental status changes and ataxia in a person without AMS

HAPE

In the setting of a recent gain in altitude, the presence of the following:

*Symptoms***:** at least two of:

- dyspnoea at rest
- cough
- weakness or decreased exercise performance
- chest tightness or congestion

*Signs***:** at least two of:

- crackles or wheezing in at least one lung field
- central cyanosis
- tachypnea
- tachycardia

Acceptance that individual differences may occur due to age, gender, experience and psychosocial influences was also considered.

Literature was reviewed from a variety of research areas including: High Altitude Medicine; Sports Nutrition; Sports Psychology; Nutrition; Hygiene and Sustainable Tourism.

5.1 Limitations to the Study

The study was retrospective and the questionnaire was sent to participants some several months after their trekking experience. The accuracy of the recall of the participants may have been affected by this time frame.

Some of the respondents had undertaken a slightly different trek, which was longer, supposedly tougher and more remote. For these individuals, exposure to altitude and exposure to other potential health risks was extended. What impact this may have had on the results is difficult to estimate, as longer exposure can help with acclimatisation. In addition individuals that chose such a trek may have had previous experience in high altitude trekking and hence may have been less vulnerable to some of the potential health problems, but of course this is not conclusive.

The author identified areas of the questionnaire which could have been improved:-

The questionnaire used a number of Likert Scale scores which as a subjective scoring mechanism are influenced by a person's attitudes, beliefs, fears, personality and accuracy of recall and hence may not reflect the actual incidence of ill health if measured objectively. However measuring how someone *feels* is fraught with difficulties as discussed in clinical literature in relation to the measurement of stress, anxiety, depression and somatic disorders (Rick & Briner, 2000; Terluin, van Rhenen & Schaufelis, 2004).

The use of Likert Scales also means that the data is ordinal and the analysis limited to non-parametric tests. Such tests lack precision and are not as powerful as parametric tests (Gravetter & Wallnau, 2000; Clegg, 2010).

The sample size is relatively small but the data recorded by the participants is consistent with other recently published research, which suggests that this is a subject which requires more detailed evaluation of the incidence and severity of physical and psychological ill health risks.

Assessment of physiological factors during the trek and direct observations of the incidence and severity of the ill health problems, their diagnosis and the provision of medication, would substantially improve the understanding of the problems experienced.

5.2 Data Analysis

The data collected was analysed using SPSS version 18.

Only the weight loss data (ratio data) was analysed using a parametric test, as most of the data collected was ordinal or nominal data.

Weight loss data was analysed using a *paired t test* to analyse the participants' weight before and after the trek to EBC.

Other tests conducted were as follows:

Scores for altitude sickness using the Lake Louise Score (ordinal data) was analysed using the non-parametric *Mann Whitney U test.* A *chi-squared test* was also conducted measuring observed against expected frequencies.

The scores for altitude sickness assessed separately under the Lake Louise Score (LLS), were summed across five questions: headaches; gastrointestinal problems; fatigue or weakness; dizziness or light headiness and difficulty in sleeping. Although it is sometimes argued that in summing 5 or more Likert scores that a parametric test could be used then the test for homogeneity was violated and hence it was decided that non-parametric tests should still be used.

In assessments between groups, the *Kruskal Wallis test* was used followed by multiple *Mann Whitney U tests*. An additional test was performed combining the data

for all severities (mild, moderate and severe) and symptoms of altitude sickness compared with those that had no symptoms and this was conducted using the *Mann Whitney U test* for independent samples.

The occurrence of increased heart rate in general and during the night was based on ordinal data and was analysed using the *Kruskal Wallis test* followed by multiple *Mann Whitney U tests* where appropriate. A *chi-squared test* was also conducted.

Ordinal data relating to low mood and whether this continued on returning home was also assessed using the *Kruskal Wallis test* followed by multiple *Mann Whitney U tests*. A *chi-squared test* was also conducted.

The data for bacterial problems was nominal data this result was analysed using the *chi squared test for association* using sickness, diarrhoea and other compared with no sickness and no diarrhoea, observed and expected frequencies.

5.3 Details of the Trek to Everest Base Camp

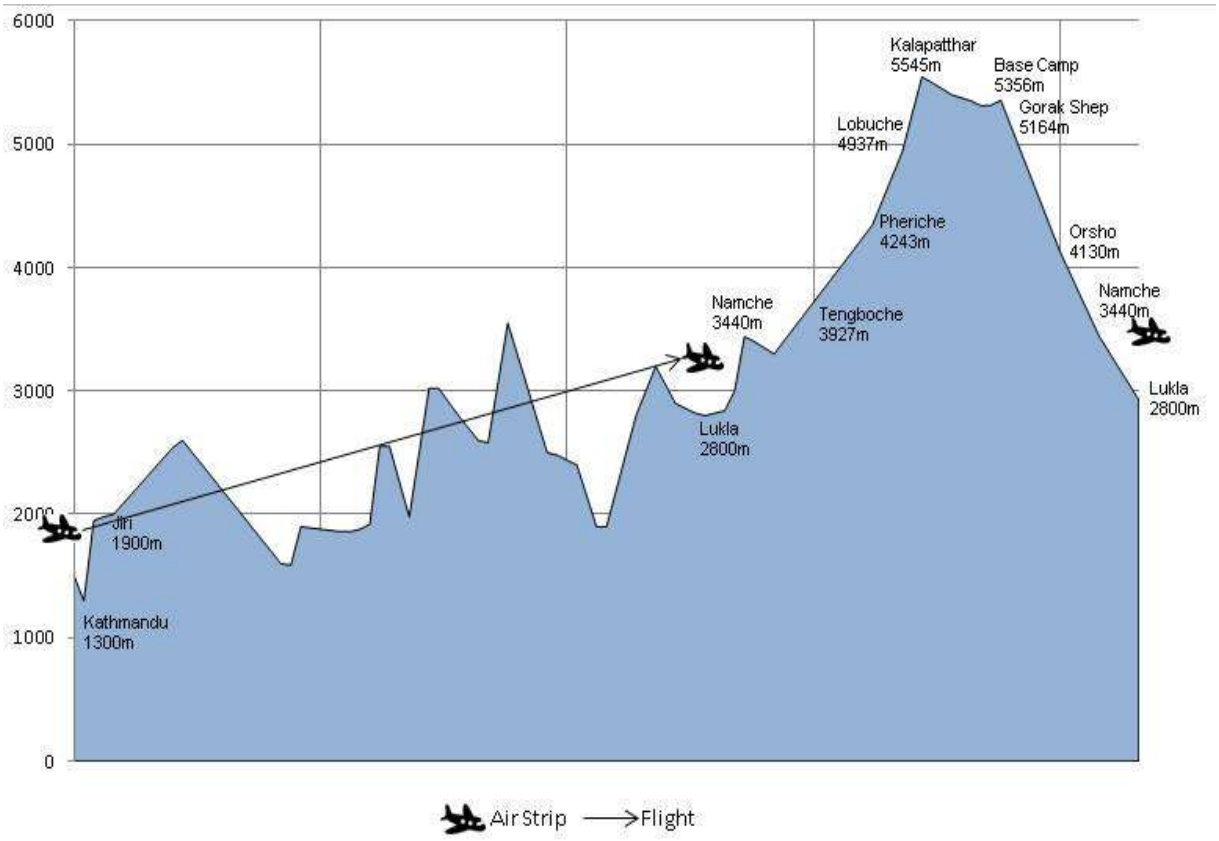


Figure 2: A Profile of the 11 day Route to Everest Base Camp

Figure 2 above provides a guide to the altitude on ascent and descent, whilst Box 4 provides a general guidance and commentary on the 11 day route to EBC. Box 5 is a very brief note of the route via Gokyo Lakes.

Box 4: The General Itinerary to Everest Base Camp

The most common trek to Everest Base Camp starts at 2850m after flying to Lukla from Kathmandu. Although there is an alternative route from Jiri (1900m) which allows more time to acclimatise, this takes an additional 3 days. Trekkers are immediately placed at an altitude sufficient to experience symptoms relating to altitude. For this reason the initial trek is 3 hours and descends to a lower elevation of 2650m at Phakding for the first overnight stay.

The second day is from Phakding to Namche Bazaar (3400 m) and is the first full day of approximately 8 hours, dependent on the pace of the group. The entry to the Sagarmatha National Park (2850m) is shortly after the village of Monjo and is the first real sign for the trekker that they are entering the Everest Region, with maps and a cut out model of the mountains which may psychologically be quite uplifting for most but may also be the point of realisation of what they are about to attempt. Namche Bazaar is the first of two planned acclimatisation stops with two nights normally spent at this location, with an acclimatisation walk intended on day 3 of the trek. Namche Bazaar is the last opportunity to shop for provisions and clothing and the last location with the luxury of flushing toilets and showers.

Day 4 is scheduled to be a trek from Namche Bazaar to Tengboche (3860m) and an opportunity to visit the Monastery. Day 5 then continues to Dingboche (4100m and a scheduled acclimatisation stop for 2 nights with day 6 being an acclimatisation walk. Day 7 ascends to Lobouche (4910m) and the excitement of only being one day away from reaching EBC.

The push on the scheduled 8th day to EBC starts at 5am stopping at Gorak Shep (5160m) for breakfast. The final trek to EBC (5440m), takes circa 2-3 hours and approximately 30 minutes of viewing the landscape at EBC before retracing steps back for an overnight stay at Gorak Shep.

Day 9 following an optional ascent to Kala Patar (5545m) to view the sunrise over Everest is the first day of descent to lower altitude. Although the terrain is rugged the rate of descent to Orsho (4100m) is far greater than the rate of ascent encouraging a more buoyant mood as pace increases and symptoms of AMS start to reduce. Day 10 is another speedy descent from Orsho to Namche Bazaar and the psychological uplift of flushing toilets and a shower. The last day of trekking is day 11 to Lukla and the opportunity to reflect on the achievement and enjoy the celebration meal. The flight from Lukla back to Kathmandu is then scheduled for day 12 weather conditions permitting.

Box 5: A Brief Outline of the Route to Everest Base Camp via Goyko Lakes.

Some participants in this study took a longer and more difficult route to EBC. After flying into Lukla, the 16 day trek ascends the mountain pass to Dole (4200m); then ascends further towards Macchermo (4410m); then Pangla (4480m) and to Goyko Lakes (4790m). The trek then continues through the Cho La Pass (5330m) and onto EBC. This trek is advertised to be 5 days longer, tougher and more remote than the standard EBC trek and trekkers spend considerably more time at a higher altitude.

5.4 Hypothesis

Altitude sickness or Acute Mountain Sickness (AMS) is a well-known physiological factor when trekking at altitude. However, confusion often exists between the symptoms of altitude related sickness and other symptoms, which may occur yet, may or may not be related to altitude.

Hypothesis 1 tested whether

There are physical ill health effects when trekking to Everest Base Camp

and

Hypothesis 2 considered whether

There are psychological effects when trekking to Everest Base Camp

6.0 Results

6.1 Response and General Information

The response to the questionnaire was 51 but 2 arrived after the completion of the analysis and therefore n = 49, with males accounting for 26 (53%) of the respondents, and females for 22 (45%) with one respondent not stating gender.

The responses to each section of the questionnaire are detailed below with additional comments made by the participants in Appendix 1. Please note, due to rounding, the individual percentage per question may not add to the 100% noted in the total.

The age breakdown (Table 9) was as follows:

Table 9: Age Breakdown of Participants

Age in years	Number	%
<21	2	4%
21-30	12	24%
31-40	12	24%
41-50	9	18%
51-60	10	20%
>60	2	4%
Incomplete	2	4%
TOTAL	**49**	**100%**

Table 10: BMI of Participants Before and After Trek

BMI Before Trek	Responses	BMI After Trek	Responses
>27	4	>27	1
25-27	14	25-27	10
22-24	17	22-24	17
19-21	7	19-21	12
<19	1	<19	3
Incomplete	6	Incomplete	6
Total	49	Total	49

Table 11: Weight Loss (kg's) of Participants

Gender	Nos.	Mean Weight Before	Range of Weight Before	Mean Weight After	Range of Weight After	Mean Weight Change	sd
Male	23	76	38(60-98)	74	32(60-92)	-2.1	± 2.6
Female	21	62	33(49-82)	58	29(49-78)	-4.1	± 3.3
Incomplete	5	-	-	-	-	-	-
Total	40	70	49(49-98)	66	43(49-92	-3.9	± 2.95

6.2 Weight Loss

Of the 49 participants in this study, 36 participants lost weight (17 male and 19 female). Mean weight of group before trek 70kgs and after 66kgs. The average weight loss was 3.9kgs, for men it was 2.1kgs and for women this 4.1kgs. The weight loss data was normally distributed and was analysed using a *paired t test* (Coakes & Steed, 2007). The results were a significant across: the total group ($p < 0.001$) sd $^{\pm}$ 2.95: for males ($p < 0.001$) sd $^{\pm}$ 2.60 and for females ($p < 0.001$) sd $^{\pm}$ 3.3.

All data outlined in the following results are ordinal and are from Likert Scales.

Although weight loss was significant, only 16% of trekkers felt that they did not get sufficient nutrition (Table 12). This may be due to individuals not realising that their appetite was suppressed. If added to those that felt that they only got sufficient nutrition on some days, then this accounts for 49% of the trekkers feeling they had insufficient nutrition.

Table 12: Sufficient nutrition from meals in the tea houses

Answer	Number	%
Not at all	8	16%
On some days	16	33%
On most days	12	24%
Every day	11	22%
Incomplete	2	4%
TOTAL	**49**	**100%**

What is also noteworthy is that 29% of trekkers felt that their appetite was not affected (Table 13) a similar figure to the 27% who did not lose weight.

Table 13: Appetite affected

Answer	Number	%
Not at all	14	29%
Sometimes	22	45%
Most of the time	9	18%
All of the time	2	4%
Incomplete	2	4%
TOTAL	**49**	**100%**

The percentage of trekkers (67%) who stated that their appetite was affected some, most or all of the time is closer to the number of people that lost weight. This suggests that these people realised that their appetite was affected and this may have been a major contributor to their weight loss, as energy intake would then be unlikely to match energy demands.

Table 14 below highlights the fact that 49% of trekkers did not feel that the lack of nutrition affected their endurance. As a trek to EBC involves several days of walking at altitude which, together with reduced nutrition, significantly increases energy requirements, then understanding how trekkers "keep going" would be worthy of further research especially as the loss of 1lb of weight is on average equivalent to a deficit of 3500 calories. As 44% of participants recognised that the lack of food was

affecting their endurance some, most or all of the time, it is clear that sufficient and appropriate nutrition is a factor.

Table 14: Whether lack of nutrition is believed to have affected endurance

Answer	Number	%
Not at all	24	49%
Some of the time	11	22%
Most of the time	7	14%
All of the time	4	8%
Incomplete	3	6%
TOTAL	**49**	**100%**

The majority, 80% (n = 39) of trekkers had undertaken other endurance events prior to trekking to EBC, and as such were likely to understand whether nutrition did or did not affect performance. Some of the trekkers 39% (n =19) would normally take additional sports supplements, whilst 14% (n=7) took such products most of the time and four individuals always took some type of sports drink or energy gels. Of the 47 trekkers that answered whether they required any additional supplementation whilst trekking, 51% (25) then stated that they required something extra occasionally, whilst 14% (7) stated that they needed something most days and 8% (4) said they needed something extra every day.

Table 15: Lake Louise (LLS) AMS Score

LLS Score	Male	Female	Total
<3	8	2	10
3-5	9	8	17
6	8	13	21
Incomplete	1	0	49

< 3 = no AMS; 3-5 = mild; 6+ = severe

The incidence of AMS using the LLS (Table 15) was: 38 with symptoms and 11 without. A *Chi-square* test using an expected frequency of 25 with and 24 without (therefore broadly 50% which is consistent with the literature) was used and the result was found to be significant ($p < 0.001$) $df = 1$; x^2 value is 11.76.

Table 16: Age and Altitude Sickness

Age	No Altitude Sickness	Mild Altitude Sickness	Severe Altitude Sickness	Total
<30	1	6	3	**10**
30-49	4	7	11	**22**
50-69	6	4	7	**17**
Total	**11**	**17**	**21**	**49**

Based on LLS: 3-5 = mild altitude sickness; 6+ = severe altitude sickness

A non-parametric *Spearman rho correlation coefficient* was undertaken to establish whether a relationship existed between age and AMS (Table 16). A modest, positive correlation was found, r value 0.5 (Cohen & Holiday, 1996) with a coefficient of

determination equalled 25%. The result was not significant but did indicate a higher incidence in the less than 30 age group (90%), with a slightly lower incidence in the 30-49 age group (82%) and a lower incidence again in the 50-69 age group (64%) and consistent with other studies discussed.

Table 17: Symptoms Experienced Relating to Altitude Sickness

Table 17a: Headache

Headache	Number	%	Mean Rank
No Headache	7	14%	4.00
Mild headache	19	39%	17.00
Moderate headache	14	29%	34.00
Severe headache	7	14%	45.00
Incomplete	2	4%	
TOTAL	**49**	**100%**	

Table 17b: Gastrointestinal

Gastrointestinal	Number	%	Mean Rank
None	19	39%	10.00
Poor appetite or nausea	21	43%	30.00
Moderate nausea &/or vomiting	5	10%	43.00
Severe nausea &/or vomiting	2	4%	46.50
Incomplete	2	4%	
TOTAL	**49**	**100%**	

Table 17c: Fatigue/weakness

Fatigue/weakness	Number	%	Mean Rank
Not tired or weak	13	26%	7.00
Mild fatigue/weakness	18	39%	22.50
Moderate fatigue/weakness	13	26%	38.00
Severe fatigue/weakness	4	8%	46.50
Incomplete	1	2%	
TOTAL	**49**	**100%**	

Table 17d: Dizziness/light-headedness

Dizziness/light-headedness	Number	%	Mean Rank
Not dizzy	27	55%	14.00
Mild dizziness	11	22%	33.00
Moderate dizziness	8	16%	43.00
Severe dizziness, incapacitating	0	0%	
Incomplete	3	6%	
TOTAL	**49**	**100%**	

Table 17e: Difficulty sleeping

Difficulty sleeping	Number	%	Mean Rank
Slept as well as usual	11	22%	6.00
Did not sleep as well as usual	18	37%	20.50
Woke many times, poor sleep	15	31%	36.50
Could not sleep at all	4	8%	46.00
Incomplete	1	2%	
TOTAL	**49**	**100%**	

If the sums of all these scores (Tables 17a to 17e) are analysed then there is a significant difference ($p < 0.001$) between those who experienced some symptoms of altitude sickness compared with those that did not experience any symptoms using *Mann Whitney U* for independent samples (Coakes & Steed, 2007).

In analysing each section independently: 17a Headaches; 17b Gastrointestinal; 17c Fatigue; 17d Dizziness; and 17e Difficulty Sleeping using *Kruskal Wallis ANOVA* for independent groups identified a significant difference ($p<0.0001$) in each section.

Post Hoc Analyses using multiple *Mann Whitney U* tests for independent samples were conducted to identify direction of the each of the four independent groups in each of the five sections. The symptoms of AMS in each section were found to be significantly different ($p <0.0001$) across all groups except one, moderate to severe Gastrointestinal ($p <0.01$).

To reduce the risk of a Type I error a bonferroni correction was applied (0.05/4) resulting in a significance level of p <0.0125, hence all results remained significant.

Using a *Chi-squared* test for observed against (expected) using the 50% incidence rate across all symptoms: 77 (110) no symptoms; 70 (80) mild; 48 (20) moderate and 15 (20) severe then the difference is very significantly different ($p<0.0001$) $df = 3$; x^2 value is 51.779.

Table 18: Altitude at which symptoms first experienced

Altitude	Number	%
<3000 metres	1	2%
3000-3500 metres	8	16%
4000-4500 metres	21	43%
4500-5000 metres	9	18%
>5000 metres	5	10%
Incomplete	5	10%
TOTAL	**49**	**100%**

Table 18 indicates that the most significant increase in incidence of AMS (43%) occurred (over 4000m) which, even though the study was retrospective and hence recall would not be as good as if conducted during the trek, is consistent with a number of studies including the study by Vardy, Vardy and Judge (2006).

Of those that stated they experienced altitude related symptoms in this section, 84% (n = 41) improved on descent, which is to be expected and is consistent with symptoms associated with altitude. However in 4% of trekkers (n=2) symptoms did

not improve and 12% (n= 6) did not complete the question of which 5 were related to those that did not complete at what altitude symptoms were first experienced. This may suggest that some people had very few symptoms, which is consistent with the Lake Louise Score.

Diamox is a medication, which is prescribed to prevent and manage altitude related symptoms but only 18% (n = 9) of trekkers took this medication (Table 19). In 3 people it resolved the problem and in 3 it improved breathing but in 2 people it increased the need to drink and in 3 people it increased the need to urinate.

Table 19: Diamox and Altitude Sickness

	None	Mild	Severe	Total
Did take Diamox	-	4	5	9
Did not take Diamox	9	13	15	37
Incomplete	2	-	1	3
Total	11	17	21	49

Based on Lake Louise Score (3-5 = mild altitude sickness, 6+ = severe altitude sickness)

Of those that took Diamox, 4 suffered mild altitude sickness and 5 suffered severe altitude sickness as assessed using the LLS. However, what is not known is how many people took Diamox before the onset of any symptoms and therefore whether they still experienced symptoms, or whether trekkers took Diamox after the onset of symptoms. As the guides were prescribing Diamox it is possible those trekkers did take Diamox post onset but the author is also aware that some trekkers did take Diamox as a precautionary measure from the outset.

In addition 65% of trekkers took Paracetamol or Anadin presumably for headaches, whilst 6% took Stemetil for sickness. Other medication (Imodium and antibiotics) were taken for symptoms such as bacterial infections which are not altitude related symptoms.

Incidence of bacterial infections (Table 20) was 57% using the figures below, which includes more than one symptom and represented 53% of trekkers. Although 23 did not answer in this section, 19 had responded to not having suffered a GI problem and therefore it is assumed that they had no symptoms. What the other category consists of in relation to bacterial problems is not known and it is possible that sickness could have been associated with an altitude related problem or that it was present with the diarrhoea. When using the *chi-squared* test for sickness, diarrhoea and other compared with an expected incidence of 8 (sickness), 10 (diarrhoea), 5 (other) and 30 (none) respectively, the association was very significant ($p < 0.001$) $df = 3$; x^2 value is 15.06. However if you used an expected incidence consistent with the incidence of visitors to the SNP then the result would not be significant.

.

Table 20: Bacterial/viral infection suffered

Answer	Number	%
Sickness	5	9%
Diarrhoea	21	40%
Other	4	8%
No Answer	23	43%
TOTAL	**53**	**100%**

Most trekkers (65%) used an antibacterial gel all of the time, with 14% most of the time, 18% some of the time and 2% not all. Cross contamination on doors and general surfaces meant it was very easy for bacteria to spread. Bacterial problems when travelling are generally well accepted and in Nepal are prevalent.

Of those that did experience a problem, 35% (n = 17) experienced a problem for 3 days or more with 12% (n = 6) having a problem for 1-2 days and 4% (n = 2) less than one day.

For 37% of trekkers they stated that this was unusual and for 16% they stated it was not and it could be assumed that this relates to when travelling. However 47% did not respond to this question and therefore were probably uncertain of what the question was aiming to establish.

Trekkers appeared to take a variety of medication. Of the 28 trekkers who responded there were 41 answers, thus some trekkers were taking more than a single medication and this was certainly observed during the trek. Medication taken included: Imodium or similar (n=15); Paracetamol/Anadin (n=14); Stemetil (n=3); antibiotics (n=6) and other medication (n = 3).

Table 21 identifies the answers to a very subjective question the result of which was 53% of trekker experienced an increase in heart rate above *expected* levels. An analysis of the four groups using the *Kruskal Wallis ANOVA* was found to be significant ($p < 0.0001$) but did not identify in which direction.

A *Post Hoc Analyses* using multiple *Mann Whitney U* tests found the ranks of those with an increase in heart rate significantly higher than those that had no increased in heart rate above expected levels. The significance is detailed in Table 21b.

Table 21a: Heart rate rise above individual expectations

Answer	Number	%	Mean Rank
No	23	47%	12.00
A little	13	27%	30.00
More than I would have expected	9	18%	41.00
Considerably more than I would have expected	4	8%	47.50
TOTAL	**49**	**100%**	

Table 21b: Results of Mann Whitney U for Independent Samples

Independent Grouping	Mean Ranks	Significance
No and a Little	12.00 and 29.50	P<0.0001
No and More	12.00 and 28.00	P<0.0001
No and Considerably	12.00 and 25.50	P<0.0001
Little and Considerably	6.50 and 14.50	P<0.0001
More and Considerably	5.00 and 11.50	P<0.001
Little and More	7.00 and 18.00	P<0.0001

To reduce the risk of a Type I error a bonferroni correction was applied (0.05/4) which equalled a significance level of 0.0125 indicating the results remained significant.

This is also consistent with a *chi-square test* which if expecting general heart rate to rise more than normal due to the altitude and the exercise therefore an expected frequency of 10, 19, 10 and 10 respectively then the result is $df = 3$; x^2 value 22.495 ($p < 0.0001$). Measuring actual HR throughout the trek would have been more valuable.

Heart rate at night (Table 22) was analysed using *Kruskal Wallis ANOVA* for independent groups and a significant difference ($p < 0.001$) was found but the direction of the difference not known.

Table 22a: Heart rate increase at night

Answer	Number	%	Mean Rank
Not at all	14	29%	7.50
A little	20	41%	24.50
On several nights	12	24%	41.00
It felt high almost every night	3	6%	46.00
TOTAL	**49**	**100%**	

A *Post Hoc Analyses* using multiple *Mann Whitney U* identified the following:

Table 22b: Results of Mann Whitney U for Independent Samples

Independent Grouping	Mean Ranks	Significance
None and A Little	7.50 and 24.50	P<0.0001
None and Several	7.50 and 20.50	P<0.0001
None and Almost Every	7.50 and 16.00	P<0.0001
Little and Almost Every	16.50 and 26.50	P<0.0001
Several and Almost Every	7.00 and 12.00	P<0.003
Little and Several	10.50 and 26.50	P<0.0001

To reduce the risk of a Type I error a bonferroni correction was undertaken (0.05/4) which equalled a significance level of 0.0125 indicating the results remained significant.

The result of a chi-square test with expected incidence of 20 (none), 19 (little), 5 (more) and 5 (considerably more) respectively would not quite be significant (p <0.07). However if the expected incidence is amended to 30, 9, 5 and 5 respectively then the result is very significant (p <0.0001) $df = 3$; x^2 value 26.98. The variances in the two results indicate the dependence on the *expected* increase. As the results in HR at night are higher than those during the day then it is possible that this increase was **not *as*** expected.

Other ill health problems (Table 23) were experienced by 77% of participants and are outlined below. This averages 1.89 symptoms per person reporting problems in this section.

Table 23: Other illnesses experienced

Condition	Number	%
Respiratory Problems	15	21%
Sore throat	14	19%
Cold/flu type symptoms	11	15%
Fever	1	1%
Aches and pains	9	13%
Racing heart rate	12	17%
Low Mood	10	14%
TOTAL	**72**	**100%**

(72 answers from 38 people who supplied answers

In addition 5 trekkers had a pre-existing condition of which 3 were asthma and hence would be more vulnerable to respiratory problems.

It was apparent that many people suffered more than one problem during the trek and that 31% of trekkers were worried about the conditions suffered, whilst 3% were very worried at the time.

Table 24: Did you feel unusually low on the trip to EBC?

Answer	Number	%	Mean Rank
Not at all	31	63%	16.00
A little	11	22%	37.00
More than usual	4	8%	44.00
Considerably more than usual	1	2%	47.00
Incomplete	2	4%	
TOTAL	**49**	**100%**	

In table 24 (n = 10) 14% of trekkers who suffered low mood and in Table 2 in response to a different question , the number who felt low on the trip was 16 (32%). The results of a *Kruskal Wallis ANOVA* were significant at the $p < 0.001$ level but this did not detail in which direction. A *Post Hoc Analyses* using *Mann Whitney U* the four independent groups of low mood namely: none; little; more and considerably more was also significant between: none and a little ($p < 0.001$); none and more ($p < 0.001$); none to considerably more ($p < 0.001$). To reduce the risk of a Type I error a bonferroni correction was undertaken (0.05/4) which equalled a significance level of $p < 0.0125$ indicating the results remained significant.

The incidence of low mood in a population of highly motivated trekkers is surprising. Although the findings are statistically significant, the size of the population and the manner in which this was assessed, e.g. a validated clinical assessment tool was not used, means that the result is not robust. However at the same time statistical significance is different to clinical significance and the incidence, severity and implications of psychological changes such as those found by Bardwell, Ensign and Mills (2005) highlighted in Table 8 suggest that this is an area for further research.

Table 25: Length of time low mood continued after returning home

Time	Number	Mean Rank
None	40	21.00
<1 week	3	43.00
1-2 weeks	1	21.00
2-3 weeks	3	46.00
4 or more weeks	2	

Of the participants, 16% (n=9) of trekkers felt that this low mood also affected them on their return home (Table 25) and that for some of the trekkers, the low mood lasted for 4 or more weeks after they returned, which is also consistent with the Bardwell, Ensign and Mills (2005) study (Table 8).

A *Kruskal Wallis ANOVA* found the result significant ($p<0.001$) but did not show in which direction. A *Post Hoc Analyses* using *Mann Whitney U* comparing each independent group found the ranks higher for those that experience < one week and between two and three weeks ($p <0.001$). The results remained significant after a bonferroni correction (0.05/4) to avoid a Type I error which equalled a significance level of $p < 0.0125$.

The majority of trekkers 76% felt motivated all (n = 20) or most (n = 17) of the time whilst 16% (n = 8) stated that they are motivated when undertaking a challenge and only two stated that they were not motivated individuals. This suggests that the low mood was unusual for most people who recognised their normal motivation levels. Furthermore, 47% (n = 23) of trekkers stated they never feel sad or depressed and 41%

(n = 20) said they only felt sad or depressed occasionally which is regarded as being fairly normal. No trekkers stated that they were sad or depressed all of the time whilst 4 were sad or depressed some of the time and 2 failed to respond to this question.

In terms of general anxiety 65% (n =32) stated that they never got anxious and 27% stated they did only occasionally, which again is quite normal and tends to be regarded as healthy anxiety. One person felt anxious more than they would like to admit and one was anxious often. Again 2 individuals failed to complete this question.

For many people a certain level of anxiety is to be expected when undertaking such a challenge but for 23 trekkers (47%) they stated that they did not get worried at all, whilst 43% (n = 21) felt a little worried which is to be expected, especially if undertaking a trek like this for the first time. Three individuals were moderately worried with two again failing to complete this question. These responses appear consistent with the number of people who had previously undertaken endurance events and therefore less likely to be worried about such a trip than trekkers undertaking such as challenge for the first time.

On returning home (Table 26) 61% (n = 30) trekkers experienced ill health problems which they did not attribute to jet lag. Of these, 19 experienced the problems for some time after. This level of ill health was significant at the $p < 0.001$ level.

Table 26: Length of time problems experienced after returning home

Time	Number
<1 week	3
1-2 weeks	4
2-3 weeks	6
4 or more weeks	5

When asked whether additional information about the different types of ill health that can occur and why, at altitude, 45% (n=27) felt it may or would have been useful and 1 thought it would have prevented unnecessary concern. A number of people stated that they did do research before the trip and hence felt well prepared. It is also well known that the more trips of this nature an individual undertakes, then the more "hardened" they become to such problems and previous experience is also likely to reduce any possible anxiety about what to expect.

6.3 Training Prior to Trek

Tables 27 to 29 detail the frequency, length of session and type of exercise taken by participants.

Table 27: Sessions per week

Sessions	Number	%
0	2	4%
1-2	10	20%
2-3	13	26%
3-4	10	20%
4-5	5	10%
5-6	7	14%
6+	1	2%
Incomplete	1	2%
TOTAL	**49**	**100%**

Table 28: Length of sessions

Time per session	Number	%
20 minutes	2	4%
40 minutes	11	22%
60 minutes	14	28%
1-2 hours	14	28%
2 hours plus	6	12%
Incomplete	2	4%
TOTAL	**49**	**100%**

Table 29: Exercise type

Type	Number	%
Hill Walking	23	18%
Running	30	23%
Cycling	21	16%
Aerobics	7	5%
Circuits	7	5%
Weights	15	12%
Rowing	5	4%
Yoga	4	3%
Pilates	2	2%
Other	16	12%
TOTAL	**130**	**100%**

Therefore trekkers were undertaking various fitness activities prior to the trek but the main activities were: hill walking (n = 11); running (n = 11); cycling (n= 15); aerobics (n = 6); circuits (n = 2) and weights (n = 3).

6.3.1 Training Specifically for the Trek to EBC

Of the 49 participants, 69% stated that they undertook specific training and 59% stated that they increased and/or changed their training specifically for the trek to EBC. This consisted of:

Table 30: Specific Training for Trek to EBC

Specific Training Type	Number	%
Hill Walking	26	31%
Running	18	21%
Cycling	9	11%
Step Aerobics	2	2%
Circuits	3	4%
Weights	10	12%
Squats	6	7%
Other	11	13%
TOTAL NUMBER OF ANSWERS	**85**	

In addition a number of individuals took medication or supplements to help with the altitude.

Table 31: Vitamins/Minerals/Medications taken to Help with Altitude

Type	Number	%
Gingko Biloba	2	10%
Altivit	2	10%
Garlic	3	14%
Diamox	7	33%
Other	7	33%
TOTAL	**21**	**100%**

Although the use of more natural substances has become popular, research has yet to prove that they are an effective method of preventing the incidence or severity of AMS (Gertsch, Basnyat, Johnson, Onopa, and Holck, 2004).

In relation to how difficult trekkers found the trek, 37% found it was less difficult than expected, whilst 19% thought that the difficulty level was as expected and 7 thought it was slightly harder than expected and 4 found it strenuous, whilst 1 response was not given.

Table 32 below details how trekkers found each section of the trek. However some individuals did not undertake this route and therefore there were a number of incomplete answers in this section. In addition many trekkers did not undertake the optional trip to Gorak Shep which was the morning after arriving at EBC and required a 4am start to view the sunset.

Table 32: How Each Section of the Trek was Rated in terms of Difficulty

Trekking Section	Easy	Quite Difficult	More Strenuous than Expected	Very Strenuous	Incomplete	Total
1 - Lukla to Namche Bazaar	28	11	6	4	0	**49**
2 – Namche Bazaar to Pangboche Monastery	18	20	6	1	4	**49**
3 – Pangboche to Gorak Shep	9	24	11	2	3	**49**
4 – Gorak Shep to EBC	6	22	9	10	2	**49**
5 – Gorak Shep to Kala Patar (optional)	4	8	3	17	17	**49**
6 – Gorak Shep to Namche Bazaar	29	14	3	2	1	**49**
7 – Namche Bazaar to Lukla	33	12	4	0	0	**49**

6.3.2 Worst and Best Aspects of the Trek

Table 33: Worst Aspects

Worst Aspects	Number	%
Altitude sickness	10	11%
Bacterial infections	7	8%
Coughing	7	8%
Cold/flu symptoms	2	2%
Feeling low/depressed	1	1%
Toilets/hygiene	22	25%
Food	10	11%
Disturbed/lack of sleep	9	10%
Cold	13	15%
Other	6	7%
TOTAL NUMBER OF ANSWERS	**87**	

(87 responses from 44 people who supplied answers)

Table 34: Best Aspects

Best Aspects	Number	%
Achieving your goal	37	15%
Scenery	42	18%
People	37	15%
Physical exercise	28	12%
Mental challenge	28	12%
Camaraderie	26	11%
The overall adventure of it all	38	16%
Other	3	1%
TOTAL NUMBER OF ANSWERS	**239**	

(239 responses from 47 people who supplied answers)

Table 35: What kept the trekkers trekking

Motivation	Number	%
Determination to succeed	36	73%
Physical fitness	30	61%
Mental stamina	27	54%
Stubbornness	12	24%
Moral support colleagues	24	49%
Moral support guides	19	38%
Other	3	6%
TOTAL NUMBER OF ANSWERS	**151**	

(151 responses from 44 people who supplied answers)

Of the 49 trekkers, 5 had pre-existing medical conditions that would have made the trek more difficult and of which, 3 individuals were asthma sufferers whose condition was likely to be exacerbated by the reduction in oxygen at altitude, combined with the cold air and dusty tracks.

Additional comments relating to the various trekkers experience can be found in Appendix 1.

6.3.3 Summary of the Results

The result was that Hypothesis 1

"That there are physical ill health effects when trekking to Everest Base Camp"

can be accepted.

The result was that Hypothesis 2

"That there are psychological ill health effects when trekking to Everest Base Camp"

can be accepted.

7.0 Discussion

Health is an emerging area in tourism research (Musa, Higham, & Hall, 2003). Although it is believed that trekking holidays have positive benefits to overall physical and psychological health, a considerable number of tourists experience some form of ill health problems whilst trekking as identified in this study and the research by Musa, Higham and Hall (2010). Their study of tourists, also visiting the SNP, from a larger population (n = 448) compares closely with the findings from this study, in that the two worst aspects of the visit was associated with toilets and hygiene and ill health, as identified in Table 36 below.

Table 36: Comparison of Top Worst Aspects of the Trek

Problem	Musa, Hall & Higham (2010)	Gellatly, 2011
Toilets/Hygiene	26%	25%
Feeling ill/getting sick	28%	29%

Of the 49 trekkers who participated, the presence of physical and psychological ill health symptoms were as follows:

Table 37: Summary of the Symptoms Experienced by Participants

Symptoms	Nos. of Symptoms
AMS	46
Weight Loss	36
HR rise more than normal at night	36
HR rise more than normal (day)	26
Bacterial problems	26
Low Mood	16
Respiratory problems	15
Sore throat	14
Racing heart	12
Cold type symptoms	11
Aches and pains	9
Fever	1
Total	**248 Symptoms**
Average	**5 Symptoms per trekker**

Although most participants had undertaken some form of endurance activity prior to the trek to EBC, most had little experience of trekking at this altitude.

The Research into Trekking at Altitude.

Research into ill health at this altitude is limited for a number of reasons. Altitude related illness is associated with the illness that only occurs because of the thin air, albeit that travel to high altitude destinations also exposes individuals to other health risks which are unrelated to the altitude, for example exposure to contaminated water. Traditionally this has only affected a small number of people, many of whom would be mountaineers who would normally phase their exposure to altitude due to the additional technicalities of climbing at altitude.

More recent journal articles are no longer limited to the High Altitude Medicine Journals, but appear in a wide range of publications including respiratory, pulmonary and cardiac systems, environmental medicine and sustainable tourism, suggesting that the interest is this subject matter is now growing across a range of clinical, environmental and tourism areas of study.

The Risk of Accurate Diagnosis

The opportunity to collect accurate data on illness is also limited in that at altitude, diagnosis is often a self-diagnosis or that of a guide. Diagnosing the difference between an illness that is specifically and solely related to the altitude, and one which is related to something totally different, is an area that even clinicians often fail to identify (Bezruchka, 2005; Farris, 2008). High altitude terrain and the manner in which altitude illness or other illnesses may arise or be masked, increases the difficulty of diagnosis across individuals.

A common theme in the literature is the potential increased risk of incidence and possible severity, due to the volume of tourists who are now travelling to high altitudes. The incidence of AMS is found to be higher in trekkers who travel in groups compared with trekkers who travel independently (Schlim & Gaillie, 1992) and as the risk profile changes to that of large groups, and the opportunity for individual variations decrease, then the risk of AMS increases.

The Pressure on the Tour Industry

As more and more trekkers seek more adventure and greater personal challenges, then the tour industry is driven to respond. As the tour industry makes such trekking more accessible, then the greater the drive to make available such opportunities in the normal 1-2 week holiday window, as opposed to the 3-4 week package previously offered. The 11 day trek to EBC can now be accommodated within the "fortnight" holiday allowance of many would be trekkers. The recommended ascent rate of: 1000 ft. (300 metres) per day above 10,000 (3050 metres) with the preference of descending slightly to sleep; together with resting every 2-3 days at the same altitude to aid acclimatisation, is not adhered to from the outset and contingency for any "incident" reduced.

The Pressure on the Guides

The guides have no previous knowledge of the trekkers and are faced with the task of taking an unknown group, with variations in age, gender, levels of fitness, personality types and the possible presence of a medical condition, from Kathmandu to EBC. From the author's observations and from the research conducted, it is common for the younger and fitter members to drive forward at a pace which may be too fast for

some or all members of the group. The guide and his assistant have to manage customer expectations and the knowledge that if the pace is too fast the risk increases, and some guides will manage this better than others.

The presence of *attitude sickness* where the naïve trekker will often deny the presence of any symptoms, can make any decision to prevent a person continuing extremely difficult (Farris, 2008). Diagnosis of AMS is difficult enough and if physicians commonly fail to identify the signs and symptoms of AMS, then it is even more difficult for the guides who are far from medical practitioners (Farris, 2008; Bezruchka, 2009.

Pressure on the Nepalese government

The Government needs to understand and manage the impact of the growth in tourism on Nepal. Commercially, tourism is good for the economy and for many locals this equates to a better standard of life. Yet as Nepal has witnessed with the Sherpa community, individuals will take risks, sometimes unnecessarily to sustain tourism and the associated income (Tenzing Norgay, 2002).

As an increasing number of Nepalese in the SNP benefit from the increase in tourism, which includes trekkers from all over the world, then this will naturally drive behaviours of guides, porters, owners of tea houses and lodges, which will focus on protecting income and hence as with the Sherpa's, may result in unsafe practices which need to be identified and managed.

Risk Management Opportunities

Although some research (Gaillard, Dellasanta, Loutan & Kayser, 2004) suggests that an increase in awareness has reduced the incidence of altitude related incidence, the volume of research, the quality of the studies and the flaws within this type of research, as Gaillard et al. recognise, suggest that more needs to be done.

Tour operators can do more to help trekkers understand the risks of trekking, not only to altitude but also to such remote areas. It is easy to assume that an individual booking such a trip will be aware of the risks and how to manage them but when booking via a tour operator, some individuals may have expectations of a greater "reliance" on the tour operator and may perceive that as an advertised "holiday" it must be safe and do not realise the difficulties of accessing medical attention should it be needed.

The tour operators should encourage individuals to visit their General Practitioners (GP's). but unfortunately many GP's will have limited experience of altitude related effects on existing medical conditions or medications Access to specialist organisations is often likely to provide more practical information. As studying the effect of altitude is not a *core* medical science, the potential for error both prior to and during a trek is considerable (Bezruchka, 2009).

Pre-trek health risk screening of any type therefore, is fraught with difficulties and although it could be offered as a service, it will not eliminate the risks and tour operators may be reluctant to introduce measures that may impact on "sales". It could

however help profile customers into possible "risk" categories which may aid group planning and at least provide the guides with some information on their trekkers.

Information provided by tour operators to trekkers needs to be consistent with the local Nepalese tour companies who also need to help improve a guide's ability to "diagnose" the range of potential ill health problems. The publications used for diagnosis need to be clearer and should provide more comprehensive help in the identification of the condition, whether related to altitude sickness or not, what action to take, what medication to provide and when.

Since an accurate assessment of altitude related illness is difficult enough, accurate assessment of other illnesses without a thorough medical assessment has to be considerably flawed. Lack of medical facilities at altitude also means that there is little clinical data to collect and the identification and management of a problem left to the guides. As the trekking community changes its profile, understanding of the *real* risks by the travelling public will change and greater expectations will be placed on the tour industry that will be criticised for failure to assess the risk and have inadequate controls in place. At the same time one of the attractions of trekking to EBC or similar is the *adventure* and tour operators have to *balance* good risk management practices with good judgement, and not introduce practices and safeguards that may remove the enjoyment factor for the majority of people that undertake such activities.

Trekkers Overall Experience

When the participants of this study were asked whether they would undertake such a trip again, 90% of the participants stated that they would. This suggests that individuals who engage in this type of activity are prepared to accept the hardships

including: lack of facilities, disturbed sleep, and lack of appetite, illness and injury and will trade these for the challenge, scenery and cultural experience. From the worst aspects of the trekkers experience if one factor could be changed then this would be the toilets and associated sanitation and hygiene.

8.0 Conclusion

Altitude related problems are an inherent risk of travelling to altitude but the incidence and severity can be reduced by better information, education and introduction of risk management related strategies. Such improvements need to involve tour operators, local tour companies and the trekking community.

The health risks associated with toilets, sanitation and hygiene. is a problem likely to escalate, with the growing number of tourists, which if not addressed, will begin to impact on the tourist trade and will become critical for the environment and the Nepalese people. Investment in better sanitation is necessary if tourism is to be sustained and the environment and all that live in the area, protected.

Furthermore, although tourism is welcomed in Nepal from an economic perspective, the health of the local people and the protection of the environment should not be ignored. To be sustainable for the future the implications for the mountains, water, flora, fauna, animals and the local people in terms of ill health and injury has to be considered.

Further and more detailed research is required to identify the incidence and severity of physical and psychological ill health, injury in tourists and to identify causation, develop suitable controls and understand, whether problems continue after leaving Nepal. The impact on the environment and the local inhabitants is even more critical, especially in the Sagarmatha National Park, in order that we may help protect the very attraction that the trekkers, climbers and general tourists seek to explore in the *World's highest mountain range.*

REFERENCES

Armellini, F., Zamboni, M., Robbi, R., Todesco, T., Bissoli, L., Mino, A., Angelini, G., Micciolo, R. & Bosello, O. (1997). The effects of high altitude trekking on body composition and resting metabolic rate. *Hormonal Metabolic Research.* 29: 458-461.

Auerbach, P.S. (2009). *Medicine for the Outdoors. The Essential Guide to First Aid and Emergencies.* Fifth Edition. Philadelphia. Mosby Elsevier.

Bardwell, W.A., Ensign, W.Y. & Mills, P.J. (2005). Negative mood endures after completion of high altitude military training. *Annuals of Behavioural Medicine.* 29: 64-69.

Basnyat, B., Lemaster, J. & Litch, J.A. (1999). Everest or Bust: a cross sectional, epidemiological survey at 4243m in the Himalaya. *Aviation Space and Environmental Medicine*. 70: 867-873.

Basnyat, B., Cumbo, T. A. & Edelman, R. (2000). Acute medical problems in the Himalayas outside the setting of altitude sickness. *High Altitude Medicine & Biology*. 1: 167-174.

Basnyat, B., Wu, T. & Gertsch, J.H. (2004). Neurological conditions at altitude that fall outside the usual definition of altitude sickness. *High Altitude Medicine & Biology*. 5: 171-179.

Baumgartner, R.W., Sigel, A.M. & Hackett, P.H. (2007). Going high with preexisting neurological conditions. *High Altitude Medicine & Biology*. 8:108-116.

Bezruchka, S. (2009). *Altitude Illness: Prevention and Treatment.* 2nd. Edition. Seattle. The Mountaineers.

Boyer, S.J. & Blume, F.D. (1984). Weight loss and changes in body composition at high altitude. *Journal of Applied Physiology*. 57: 1580-1585.

Brundrett, G. (2002). Sickness at high altitude: a literature review. *The Journal of the Royal Society for the Promotion of Health.* 122(1): 14-20.

Burke, L. & Deakin, V. (2007). *Clinical Sports Nutrition.* Third Edition. North-Ryde. McGraw-Hill.

Centers for Disease Control and Prevention (1999-2000). *Health Information for the International Traveller.* DHHS. Atlanta.

Christensen, E.H. & Forbes, W.H. (1937). Oxygen Consumption and Respiratory Function at High Altitude (translated). *Skand. Arch Physiology.* 76: 75-87.

Clegg, F. (2010). *Simple Statistics.* Cambridge. Cambridge University Press.

Coakes, S.J. & Steed, L.G. (2007). *SPSS version 14.0 for windows: Anaylsis without anguish.* Queensland. Wiley.

Cohen, L & Holiday, M. (1996). *Practical Statistics for Students. An Introductory Text.* London, Paul Chapman Publishing.

Dietz, T.E. (2000). Lake Louise Score (LLS) for the diagnosis of Acute Mountain Sickness (AMS). http://www.high-altitude-medicine.com

Edwards, L.M., Murray, A.J., Tyler, D.J., Kemp, G.J., Holloway, C.J., Robbins, P.A., Neubauer, S., Levett, D., Montgomery, H.E., Grocott, M.P., Clarke, K. (2010). The Effect of High-Altitude on Human Skeletal Muscle Energetics: P-MRS Results from the Caudwell Xtreme Everest Expedition. *PLoS ONE 5(5): e10681.* Caudwell Xtreme Everest Research Group.

Farris, M. (2008). *The Altitude Experience: Successful Trekking and Climbing above 8000 feet.* Guilford. Falcon Publishing.

Gaillard, S., Dellasanta, P., L. Loutan, L., & Kayser, B. (2004). Awareness, prevalence, medication use and risk factors of acute mountain sickness in tourists trekking around the Annapurna's in Nepal: a 12-year follow up. High Altitude Medicine & Biology. 5: 410-419.

Gravetter, F.J. & Wallnau, L.B. (2000). *Statistics for Behavioural Sciences.* Fifth Edition. Belmont. Wadsworth.

Hackett, P.H. (1995). *High Altitude Medicine*. In: *Wilderness Medicine: Management of Wilderness and Environmental Emergencies.* 3rd Edition. St. Louis. Mosby.

Hadolt, I. & Litscher, G. (2003). Non-invasive assessment of cerebral oxygenation during high altitude trekking in the Nepal Himalayas (2850m-5600m). *Neurological Research.* Volume 25:Nos 2: 183-186.

Hashimoto, F., McWilliams, B. & Qualis, C. (1997). Pulmonary ventilatory function decreases in proportion to increasing altitude. *Wilderness & Environmental Medicine.* 8(4): 214-217.

Honigman, B, Theis, M.K., Koziol-McLain, J., Roach, R., Yip, R., Houston, C., Moore, L.G. & Pearce. P. (1993). Acute mountain sickness in a general tourist population at moderate altitudes. *Annuals of Internal Medicine.* 118(8):587-92.

.

Hoppeler, H., Vogt, M., Weibel, E.R. & Fluck, M. (2003). Response of skeletal muscle mitochondria to hypoxia. *Experimental Physiology.* 88.1: 109-119.

Hornbein, T. and Schoene, R.B. (2001). High altitude: An exploration of human adaptation. *Lung Biology in Health and Disease.* Vol. 161.

Hultgren, H.N. (1997) *High Altitude Medicine.* Stanford. Hultgren Publications.

Harfarian, S., Gorouhi, F., Ghergherechi, M. & Lofti, J. (2007). Respiratory Rate within the First House of Ascent Predicts Subsequent Acute Mountain Sickness. *Archives of Iranian Medicine. 11(2): 152-156.*

Jun, J. & Polotsky, V.T. (2011). Metabolic Consequences of Sleep-Disordered Breathing. *n/ilar/ejournal online*. Vol: 5 (3).

Kanai, M., Nishihara, F., Shiga, T., Shimada, H. & Salto, S. (2001). Alterations in autonomic nervous control of heart rate amongst tourists at 2700m and 3700m above sea level. *Wilderness and Environmental Medicine.* Volume 12: 1: 8-12.

Karinen, H., Peltonen, J. & Tikkanenen, H. (2008). Prevalence of Acute Mountain Sickness amongst Finnish Trekkers on Mount Kilimanjaro, Tanzania: An Observational Study. *High Altitude Medicine and Biology.* Volume 9: Number 4.

Kayser, B. (1992). Nutrition and High Altitude Exposure. *International Journal of Sports Medicine.* 13:S129-132.

Kilner, T. & Mukerji, S. (2010). Acute mountain sickness prophylaxis: Knowledge, attitudes & behaviours in the Everest region of Nepal. *Travel Medicine and Infectious Diseases.* Volume 8: 6: 395-400.

Kim, Y.Y & Lee, S.M. (2007). Treatment and Prevention of High Altitude Illness and Mountain Sickness. *Journal of Korean Medical Association.* 50 (11): 1005-1015.

Kostyo, J.L., and Goodman H.M. (2001) *Handbook of Physiology: Section 7: The Endocrine System: Vol. 5, Hormonal Control of Growth.* Oxford. Oxford University Press.

Kupper, T.E.B., Schraut, B. & Rieke, Hemmerling, A.V., Volker, S. & Juergen, S. (2006). Drugs and drug administration in extreme environments. *Journal of Travel Medicine.* 13: 35-47.

Levine, B.D. (2002). Intermittent hypoxic training: Fact and fancy. *High Altitude Medicine and Biology.* 3 (2): 177-193.

Levine, B.D., Zuckerman, J.H. & diFillippi, C.R. (1997). Effect on high altitude exposure in the elderly: The Tenth Mountain Division study. *Circulation.* 96 (4): 1224-32.

Lundy, C. & van Hall, G. (2004). Peak Heart Rates at Extreme Altitudes. *High Altitude Medicine and Biology.* Vol. 2 (1). 41.45.

Lundy, C., Pilegaard, H. Anderson, J.L., Van Hall, G., Sander, M. & Calbert, J.A.L. (2004). Acclimatisation to 4100m does not change capillary density or mRNA expression of potential angiogenesis regulatory factors in human skeletal muscle. *The Journal of Experimental Biology.* 207: 3865-3871.

Mader, T.H. & Tabin, (2003). Going to high altitude with preexisting ocular conditions. *High Altitude Medicine and Biology.* 4 (4): 419-430.

Manousou, E., Argiriadou, E., Iliadis, A., Mavrovouniotis, F. & Tsiligiroglou-Fachantidou, A. (2011). Body Weight State and Diet of Greek Mountaineers During Their Stay at High Altitude. *Physical Training.*

Martin, L. (1997). *Scuba Diving Explained: Questions and Answers on Physiology and Medical Aspects of Scuba Diving.* Arizona. Best Publishing.

Mental Health Foundation (2009). *Moving on Up*. London. Mental Health Foundation.

Murdoch, D.R. & Curry, C. (1998). Acute mountain sickness in the Southern Alps of New Zealand. The New Zealand medical journal.111 (1065): 168-169

Musa, G., Hall, C.M. & Higham, J.E.S. (2004). Tourism sustainability and health impacts in high altitude and adventure, cultural and ecotourism destinations: a case study of Nepal's Sagarmatha National Park. *Journal of Sustainable Tourism.* 12 (4): pp 306-331.

Musa, G. (2005). *The importance of Health as a Factor in achieving Sustainability in a High Altitude Destination of a less Developed Country: A Case Study of Sagarmatha National Park.* Chapter 8: In: *Nature Based Tourism in Peripheral Areas: Development of Disaster*? Hall, C.M. and Boyd, S.W. Channel View Publications.

Nerin, M.A., Palop, J., Montano, J.A., Morandeira, J.R. and Vazquez, R.N. (2008). Acute Mountain Sickness: Influence of Fluid Intake. *Wilderness and Environmental Medicine.* Volume 17: 4: 215-220.

Ri-Li, G., Chase, P.J., Witkowski, S., Wyrick, B.L., Stone, J.A., Levine, B.D. & Babb, T.G. (2003). Obesity: Associations with Acute Mountain Sickness. *Annals of Internal Medicine.* 139(4). 253-257.

Rick, J. & Briner, R.B. (2000). Psychosocial risk assessment: problems and prospects. *Occupational Medicine*. 50: 310-314.

Roach, R.C., Houston, C. S., Honigman, B., Nicholas, R. A., Yaron, M. C., Grissom, C. K., Alexander, J. K. & Hultgren, H. N. (1995). How well do older persons tolerate moderate altitude? Western Journal of Medicine. 162(1): 32–36

Roeggla G, Roeggia M, Podolsky A, Wagner A, & Laggner, A.N. (1996) How can acute mountain sickness be quantified at moderate altitude? *Journal of the Royal Society Medicine*.89:141–143.

Rosenbaum, P.R. (2005). Observational Study. *Encyclopedia of Statistics in Behavioural Science.* Volume 3. pp. 1451-1462.

Scarp, A. & Luscher K.A. (2002). Self-esteem, cortisol reactivity, and depressed mood mediated by perceptions of control. *Biological Psychology.* 59*:*93–103.

Schlim D.R. & Gaillie, J. (1992). The cause of death among trekkers in Nepal. *International Journal of Sports Medicine.* 13 (Supp. 1): S74- S76.

Simon-Schnass, I.M. (1992). Nutrition at high altitude. *Journal of Nutrition.* 122(3Suppl): 778-781.

Spiegel, D. & Giese-Davis, J. (2003). Depression and cancer: Mechanisms and disease progression. *Biological Psychiatry.* 54:269–282.

Sullivan, M.J.L., Feuerstein, M., Gatchel, R., Linton, S.J. & Pransky, G. (2005). Integrating psychosocial and behavioural interventions to achieve optimal rehabilitation outcomes. *Journal of Occupational Rehabilitation.* 15: 475-489.

Sutton, J.R., Coates, G. & Houston, C.S. (1992). *The Lake Louise Consensus on the Definition and Quantification of Altitude Illness in* Hypoxia and Mountain Medicine. Vermont. Queen City Printers.

Terluin, B., Van Rhenen, W., Schaufelis, W.B. & De Haan, M. (2004) The Four-Dimensional Symptom Questionnaire (4DSQ) measuring distress and other mental health problems in a working population. *Work and Stress*. July. Vol: 18. No. 3:187-207. Taylor and Francis.

The Management of Health and Safety at Work Regulations. (1999). Statutory Instrument. Her Majesty's Stationery Office. London.

Vardy, J., Vardy, J. & Judge, K. (2006). Acute Mountain Sickness and Ascent Rates in Trekkers above 2500, in the Nepali Himalayas. *Aviation Space and Environmental Medicine.* Volume 77: 7: 742-744.

Waddell, G., Burton, K. & Kendall, N. (2008). *Vocational Rehabilitation: What works, for whom and when?* London. The Stationery Office.

Westerterp, K.R. (2001). Energy and Water Balance at High Altitude. *News in Physiology Science.* Vol. 16: 134-137.

Wilkerson, J.A., Moore, E.E., & Zafre, K. (2010). *Medicine for Mountaineering & Other Wilderness Activities.* Sixth Edition. Seattle. The Mountaineering Books.

Zafren, K. & Honigman, B. (1997). High Altitude Medicine. *Emergency Medicine Clinic of North America.* 15(1). 199-222.

Bibliography

Acton, C. & Miller, R. (2009). *SPSS for Social Scientists.* Second Edition. London. Palgrave MacMillan.

Biddle, S.J.H. & Mutrie, N. (1991) *Psychology of physical activity: A health related perspective.* London: Springer-Verlag.

Biddle, S.J.H., Fox, K.R. & Boutcher, S.H. (2000). *Physical Activity and Psychological Well-Being.* London. Routledge.

Biddle, S.J.H., Fox, K.R. & Boutcher, S.H. (2000). *Physical Activity and Mental Health*: *A National Consensus*. London. Routledge.

Biddle, S.J.H. & Mutrie, N. (2008). *Psychology of Physical Activity: Determinants, well being and interventions.* 2nd Edition. Abingdon. Routledge.

Brown, G. (2009). *The Biopsychosocial Approach.* Module 8. [Lecture to General Practitioners]. British Institute of Musculoskeletal Medicine.

Coakes, S.J & Steed, L.G. (2007).*SPSS version 14.0 for windows: Analysis without anguish.* Queensland, Wiley

Cohen, L & Holiday, M (1996). *Practical Statistics for Students: An Introductory test.* London, Paul Chapman Publishing.

Department of Health. (2001). The *National Quality Framework Assurance for Exercise.* London. DOH.

Department of Health. (2004a). *At Least Five a Week.* London. DOH.

Department of Health. (2004b). *Choosing Health: Making Healthier Choices Easier.* London. DOH.

Department of Health. (2004c). *Evidence on the impact of physical activity and its relationship to health*. London. DOH.

Department of Health. (2005). *Health, work and well-being- Caring for our future: A strategy for the health and well being of working age people.* London. DOH.

Faulkner, G. & Taylor, A. (2007). *Exercise, Health and Mental Health: Emerging Relationships.* New York. Routledge.

Faulkner, G. and Taylor, A. (2009). Promoting physical activity for mental health: A complex intervention? Editorial. *Mental Health and Physical Activity.* 1-3.

Gondoh, Y., Sensui, H., Kinomura, S., Fukuda, H., Fujimoto, T., Masud, M., Nagmatsu, T., Tamaki, H. & Takekura. (2009). Effects of aerobic exercise training on brain structure and psychological well-being. Exercise physiology and Biomechanics. *Journal of Sports Medicine Physical Fitness:* 49:129-135.

Hamer, M., Stamatakis, E. and Steptoe, A. (2009). Dose-response relationship between physical activity &mental health: the Scottish Health Survey. *British Journal of Sports Medicine.* 43: 1111-1114.

Hinton, P.R., Brownlow, C., McMurray, I. & Cozens, B. (2004). *SPSS Explained.* Hove. Routledge.

Hoffman, P. (1997). *The Endorphin Hypothesis*. Physical Activity and Mental Health. Chap. 10. 163-176.

Lloyd-Williams, F. & Mair, F. (2005). *The role of exercise in recovery from heart failure.* Chapter 5. Exercise, Health and Mental Health. Edited Faulkner, G.E.J. and Taylor, A.H. London. Routledge.

McCardle, W.D., Katch, F.I. & Katch, V.L. (2007). *Exercise physiology. Energy, Nutrition and Human Performance. Sixth edition*. Baltimore. MD. Lippincott Williams and Wilkins.

Mental Health Foundation (2005). *Up and Running?* London. Mental Health Foundation.

Moonen, H.M.R., Van Boxtel, M.P.J., de Groot, R.H.M. and Jolles, J. (2008). Improvement in physical functioning protects against cognitive decline: A 6-

year follow up in the Maastricht Aging Study. *Mental Health and Physical Activity.* 1: 62-68.

Mutrie, N. (2002). Healthy body, healthy mind? *Psychologist.* 15. 412-413.

Vuilleman, A., Bioni, S., Bertrais, S., Tessiers, S., Oppert, J.M. and Herchberg, S. et al, (2005). Leisure time physical activity and health-related quality of life. *Preventative Medicine.* 41. 562-569.

Waddell, G. and Burton, K. (2005). *Concepts of Rehabilitation for the Management of Common Health Problems.* London. The Stationery Office.

World Health Organisation. (2000). *The World Health Report: Health Systems: Improving Performance.* Geneva. WHO.

Glossary of Terms

Acclimatisation – The process of the body adapting to less oxygen in the air at altitude.

Acute Mountain Sickness – Normally identified at 2000m or above following a recent gain in altitude. Symptoms include: Gastrointestinal (poor or no appetite, nausea or vomiting); Fatigue or weakness; Dizziness or light headedness; difficulty sleeping.

Altered Mental Status – A change in the level and functioning of the psyche (a person's intellectual functioning, including emotional, attitudinal, psychological and personality aspects).

Altitude Illness – The totality of conditions associated with not feeling well at altitude.

Apnoeic – Breathless or the suspension of breathing.

Ataxia – Altered balance and muscular co-ordination resulting from the brain not working correctly.

Attitude Illness – Denial of altitude illness because of ego, self-image and one's relationships with others in the group.

Cyanosis – A bluer skin colour than normal, reflecting the inability to transport oxygen.

Diuresis – An increase in urination.

Granulocytes – White blood cells.

Granulocytocis - Additional white blood cells in the peripheral blood.

High Altitude Cerebral Edema – (HACE) – In the setting of a recent gain in altitude the presence of change of mental status, ataxia or both in a person with or without AMS.

High Altitude Edema – (HAE) Swelling of the face, hands or ankles at altitude.

High Altitude Pulmonary Edema – (HAPE) – In the setting of a recent gain in altitude the presence of two each of the following: Signs – rales (crackles) or wheezing in a least one lung; central cyanosis; rapid breathing; rapid heartbeat: Symptoms: shortness of breath at rest; cough; weakness or decreased exercise performance; chest tightness or congesting.

High Altitude Retinopathy – (HAR) -Changes in the retina of the eyes at altitude, in which there is bleeding and other pathology.

High Altitude syncope – Fainting that occurs after eating and standing up in the first 24 hours after arrival at intermediate altitudes. The faint is followed by a quick recovery.

Hypoxia - is a pathological condition in which the body as a whole (generalized hypoxia) or a region of the body (tissue hypoxia) is deprived of adequate oxygen supply

Periodic Breathing – During sleep, cyclical changes in the rate and depth of breathing from rapid and strong to weak and almost imperceptible,

Appendix 1: Additional Comments from Participants

Comments and Observations

- Most of party, including. Leader suffered from wind burn due to bad weather going over Cho La Pass. Effected lips & cheeks and took days to recover.
- Trek undertaken to EBC was via Gokyo Lakes, Gokyo RI & Cho La Pass.
- Took Whey Protein powder with me for the whole trip. Looks as if form is incomplete but N/A was applied to Altitude and illness sections!
- Slightly different trek via Gokyo Lakes & over the Cho La Pass. Longer route.
- Fantastic experience. Well looked after.
- Lots of walking at work. Various sports most of life.
- Expecting trip to be more challenging, pleased it wasn't. Reasonably fit but very concerned that an hour walking up hill on a treadmill would not be enough. Cold, worst aspect.
- Surprised how long bacterial infection hung around.
- Huge amount of research, spoke personally to x 3 people, very prepared, amazing group.
- Effects of altitude - Namche, impaired judgement and things more amusing. Light sleep but not tired. Advice from guides good. Cold temperatures main challenge on trip.
- Loved trip, really well organised with plenty of acclimatisation. This meant 100% of group reached base camp.
- Adequately prepared, Heating/light stoves/night.
- EBC trip - part of London Marathon training. Prepared for both with c 18 mile runs. On return, caught stomach bug - unable to run until Marathon day. EBC trip was incredible.
- I only started to feel nausea the night before EBC. Mainly due to guide taking us up a hill/incline too fast. The nausea never went till the decent. EBC - very

long day, by the time I got back to Gorak Shep I felt sick due to exhaustion so I took a Diamox. But only once. I only suffered from lack of sleep the night of the ascent to EBC. Every other night I slept well but I got a cough when back in Kathmandu that became an ear infection back home.

- Knowing likely illness & bringing meds helped. Effects of basic living, poor hygiene, lack of nutrition, intense exercise, lack of sleep showed very quickly. Took Multi vitamins.
- Worst day Gorak Shep to Kala Patar-long day. Low and tired, hard to keep going. After better food/conditions - Namche, things were great.
- Altitude sickness was apparent above 4500m, especially at night. Throbbing headache, lack of sleep, dizziness, sickness diarrhoea etc. Gradually got better as the day (and activity) started. Quite incapacitating on morning of climb to Kalar Partar got better on descent. Paracetamol, codamol and diclotenac helped (may have been a placebo) although only losing altitude stopped symptoms. I made an effort to always stay hydrated.
- Read a lot about what to expect, well prepared in advance. Well travelled. Others who were not experienced struggled more.
- Felt very spaced out at altitude, especially last 2 days. Could not sleep well & not at all at Gorak Shep. Had heart palpitations, almost like a panic attack, due to lack of breath. Very tired due to lack of sleep. All symptoms stopped at Namche Bazaar. Awesome trip!!
- Diarrhoea sapped energy, surprised to feel depressed on return.
- Got very sick, biggest challenge was health issue. Would try trekking with own cook.
- Oxygen available at the tea houses should be mandatory.
- Suffered from booking holiday too far in advance. Over preparation. Found it difficult to keep up with younger age groups. These made up most of the numbers in the group.

Appendix 2: Lake Louise Score (LLS)

Lake Louise Score (LLS)

for the diagnosis of Acute Mountain Sickness (AMS)

A diagnosis of AMS is based on:

1. A rise in altitude within the last 4 days

2. Presence of a headache

PLUS

3. Presence of at least one other symptom

4. A total score of 3 or more from the questions below

LAKE LOUISE: SELF-REPORT QUESTIONNAIRE

Add together the individual scores for each symptom to get the **total score.**

Headache	No headache	0
	Mild headache	1
	Moderate headache	2
	Severe headache, incapacitating	3
Gastrointestinal Symptoms	None	0
	Poor appetite or nausea	1
	Moderate nausea &/or vomiting	2
	Severe nausea &/or vomiting	3

Fatigue &/or weakness	Not tired or weak	0
	Mild fatigue/weakness	1
	Moderate fatigue/weakness	2
	Severe fatigue/weakness	3

Dizziness/light headedness	Not dizzy	0
	Mild dizziness	1
	Moderate dizziness	2
	Severe dizziness, incapacitating	3

Difficulty sleeping	Slept as well as usual	0
	Did not sleep as well as usual	1
	Woke many times, poor sleep	2
	Could not sleep at all	3
	TOTAL SCORE	

Total score of:

□□3 to 5 = mild AMS

□□6 or more = severe AMS

Note:

□□Do not ascend with symptoms of AMS

□□Descend if symptoms are not improving or getting worse

□□Descend if symptoms of HACE or HAPE develop

Appendix 3: Sample of the Questionnaire and Letters Sent to Participants

Letter of Invitation (for participants the Lead Researcher met)

Dear [Named Individual]

You may recall we met in November on the trek to Everest Base Camp (EBC) with the Adventure Company. You may have also heard me chat about my interest in collecting data from trekkers to EBC to help other trekkers better prepare for such a trip, reduce the risk of ill health and injury and to help the Adventure Company and potentially other tour operators consider what more could or should be done to improve the trip for tourists and also help reduce the negative impact of tourism to the local people in the Sagarmatha region.

I would therefore be extremely grateful if you could take time to complete this questionnaire as openly as you can recall. By now you have probably forgotten any of the negative aspects of the trip and hopefully only recall the scenery, the people and the fun we had but I would ask that you cast your mind back to every day of the trip and consider how you felt both physically and mentally on each day and with the trip overall.

The questionnaire is anonymous and you do not have to give me your name or address if you do not wish to. However I am also willing to offer you £25 in either Marks and Spencer or Boots vouchers. Alternatively I am happy to donate £25

amount for each questionnaire completed to a Gurkha Charity for ex Gurkhas and their Families. If you would like to receive the vouchers then just let me have your address (no need for a name unless you want to).

Please also read the Participant Information Sheet. If you would also like to receive a summary report following the study then I would be happy to send this to you once this has been marked by University of Chester.

A stamped address envelope is provided for the return of the questionnaire to:

Strictly Private and Confidential, Pamela Gellatly.

Thank you in anticipation of your response and happy future trekking

Yours sincerely

Pamela Gellatly

Participant Information Sheet

The Physical and Psychological Ill Health Effects of Trekking to Everest Base Camp.

You are being invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. If there is anything that is not clear or if you would like more information then please contact the Lead Researcher. Take time to decide whether or not you wish to take part.

Thank you for reading this.

What is the purpose of the study?

This research is being undertaken on adults who have trekked or attempted to trek to Everest Base Camp recently. The project is to find out what physical and psychological ill health were experienced by trekkers when trekking to Everest Base Camp due to altitude, water or other for other reasons. The impact of both the physical and psychological stressors both during and after the trek will also be used to help other trekkers better prepare (where possible) for such an adventure.

Why have I been chosen?

Because you have taken part in a trek to Everest Base Camp.

Do I have to take part?

It is up to you to decide whether or not to take part. If you decide to take part you will be given this information sheet to keep. If you decide to take part you are still free to withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision not to take part, will not affect you in any way.

What will happen to me if I take part?

You will simply need to complete the attached questionnaire. You will be asked to recall your experience during the trek about how you felt both physically and psychologically. You will also be asked a number of questions relating to what preparation you did prior to the trek and how you felt after the trek.

The questionnaire is anonymous and the data will be viewed and processed by the Lead Researcher.. The results of the study will form part of my dissertation for my MSc in Exercise and Nutrition. A report from this work will be reviewed by the University of Chester and will also be forwarded to the Adventure Company.

What are the possible disadvantages and risks of taking part?

There are no disadvantages or risks foreseen in taking part in the study.

What are the possible benefits of taking part?

If you would like to receive a summary of the findings then this can be sent to you if you are happy to provide an email or postal address. You may find the information of interest if you are planning another trip to the Everest region or other high altitude adventure. The main benefit is to help others understand the potential ill health risks of such a trek so they may better prepare.

Furthermore it is hoped that such research will help in the development of a sustainable tourism programme for the Everest region which will also vastly benefit the local people.

What if something goes wrong?

If you wish to complain or have any concerns about any aspect of the way you have been approached or treated during the course of this study, please contact Professor Sarah Andrew, Dean of the Faculty of Applied Sciences, University of Chester, Parkgate Road, Chester, CH1 4BJ, 01244 513055.

Will my taking part in the study be kept confidential?

All information which is collected about you during the course of the research will be kept strictly confidential so that only the researcher carrying out the research will have access to such information.

What will happen to the results of the research study?

The results will be written up into a dissertation as part of a final project for an MSc., in Exercise and Nutrition. Individuals who participate will not be identified in any subsequent report or publication.

Who is organising the research?

The research is conducted as part of an MSc in Exercise and Nutrition Science within the Department of Clinical Sciences at the University of Chester. The study is organised with supervision from the department, by Pamela Gellatly, an MSc student.

Who may I contact for further information?

If you would like more information about the research before you decide whether or not you would be willing to take part, please contact:

k

or telephone: 0

Thank you for your interest in this research.

Letter of Invitation (for participants the Lead Researcher did not meet

Dear [Named Individual]

If you receive this letter then it is because you have recently trekked to Everest Base Camp (EBC) with the Adventure Company.

I undertook the same trek in November 2010 and during the trek became very interested in the experiences observed of the fellow trekkers who participated. This led me to the decision to explore the physical and psychological ill effects experience by trekkers undertaking this trip as part of my MSc in Exercise and Nutrition which I am studying at the University of Chester.

The purpose of the research is to better prepare for such a trip, reduce the risk of ill health and injury and to help the Adventure Company and potentially other tour operators consider what more could or should be done to improve the trip for tourists and also help reduce the negative impact of tourism to the local people in the Sagarmatha region.

I would therefore be extremely grateful if you could take time to complete this questionnaire as openly as you can recall. By now you have probably forgotten any negative aspects experienced and hopefully only recall the scenery, the people and the fun you had but I would ask that you cast your mind back to every day of the trip and consider how you felt both physically and mentally on each day and with the trip overall.

The questionnaire is anonymous and you do not have to give me your name or address if you do not wish to. Please also read the Participant Information Sheet. If you would also like to receive a summary report following the study then I would be happy to send this to you once this has been marked by University of Chester.

A stamped address envelope is provided for the return of the questionnaire to:

Thank you in anticipation of your response and happy future trekking

Yours sincerely

Pamela Gellatly

Trek to Everest Base Camp

Questionnaire to collate information on potential ill health effects

Introduction

The questionnaire outlined below is designed to identify the preparation you undertook before the trip to Everest Base Camp (EBC) and collate information on any ill health effects you experienced both during and after the trek.

The data collected will be used as part of my dissertation for an MSc in Exercise and Nutrition for which I am studying at the University of Chester. The data will only be viewed by the Lead Researcher for this purpose and used for analysis of physical and ill health effects.

Please complete the questionnaire based on what you actually experienced during the trip and return to me in the stamped addressed envelope to the following address: Strictly Private and Confidential,

Thank you in anticipation of your response.

Pamela Gellatly

Please also tick whether you would like to:

Receive £25 in Marks and Spencer Vouchers ☐

Donate the £25 I am willing to pay you for completion of the questionnaire to the Gurkha ☐ Charity as outlined in the attached letter

Should you wish to receive the Marks and Spencer vouchers then please enclose the address you would like the vouchers forwarded to.

Section 1 – Information on You, Exercise and Training for the Trip

Please complete the following as accurately as possible:

(NB It is accepted that you may not have the exact answers to all of these questions but please complete as many as possible).

<table>
<tr><td>Current Age</td><td colspan="4"></td></tr>
<tr><td>Height</td><td colspan="4">☐ feet and inches ☐ centimetres</td></tr>
<tr><td>Weight</td><td>Prior to the Trek</td><td>☐ st & lb
or
☐ kg</td><td>after the Trek</td><td>☐ st & lb
☐ kg</td></tr>
<tr><td>Gender</td><td colspan="4">☐ Male ☐ Female</td></tr>
<tr><td>Occupation</td><td colspan="4"></td></tr>
<tr><td colspan="5">Normal Exercise per Week</td></tr>
<tr><td colspan="5">Number of sessions per week</td></tr>
<tr><td colspan="2">☐ 0
☐ 1-2
☐ 2-3
☐ 3-4</td><td colspan="3">☐ 4-5
☐ 5-6
☐ 6+</td></tr>
<tr><td colspan="5">Average length (time) per session</td></tr>
<tr><td colspan="2">☐ 20 mins
☐ 40 mins
☐ 60 mins</td><td colspan="3">☐ 1-2 hours
☐ 2 hours plus</td></tr>
</table>

<table>
<tr><td colspan="3">Type of Exercise:

(Please tick more than one if applicable)</td></tr>
<tr><td colspan="2">☐ Hill Walking
☐ Running
☐ Cycling
☐ Aerobics
☐ Circuits</td><td>☐ Weights
☐ Rowing
☐ Yoga
☐ Pilates
☐ Other</td></tr>
<tr><td>Have you undertaken any endurance events before?</td><td colspan="2">☐ Yes ☐ No</td></tr>
<tr><td>If yes, please state type of event, length of event etc.</td><td colspan="2"></td></tr>
<tr><td>Did you do any specific training for the trip</td><td colspan="2">☐ Yes ☐ No</td></tr>
<tr><td>If yes, please state what type of training</td><td>☐ Hill Walking
☐ Running
☐ Cycling
☐ Step Aerobics</td><td>☐ Circuits
☐ Weights
☐ Squats
☐ Other</td></tr>
</table>

Did you increase or change the training over and above what you have outlined above?	☐ Yes ☐ No	
Did you take any vitamins / minerals / medications to help with the altitude?	☐ Gingko Biloba ☐ Altivit ☐ Garlic	☐ Diamox ☐ Other (Please state)
How strenuous did you find the trek?	☐ Less Strenuous Than Expected ☐ As Expected ☐ Slightly More Strenuous than expected ☐ Very Strenuous	
Did you feel that your heart rate increased above what you would expect for the level of exercise?	☐No ☐A little (I think) ☐More than I would have expected ☐Considerably more than I would have expected	
Did you experience an increase in heart rate at night?	☐Not at all ☐A little (I think) on occasions ☐On several nights ☐It felt high almost every night	

Section 2 – How Difficult was each section of the trek?

Please cast your mind back to each day of the trek and recall how you felt – physically. The trek has been split into sections to help you recall both the ascent and descent. Please answer the questions based on which answer reflects how you felt at the time rather than how you may remember it now.

Trekking Sections	Scale of Difficulty
Section 1 Lukla to Namche Bazaar	☐ Easy ☐ Quite Difficult ☐ Slightly More Strenuous than expected ☐ Very Strenuous
Section 2 Namche Bazaar to Pangboche Monastery	☐ Easy ☐ Quite Difficult ☐ Slightly More Strenuous than expected ☐ Very Strenuous
Section 3 Pangboche to Gorak Shep	☐ Easy ☐ Quite Difficult ☐ Slightly More Strenuous than expected ☐ Very Strenuous
Section 4 Gorak Shep to EBC	☐ Easy ☐ Quite Difficult ☐ Slightly More Strenuous than expected ☐ Very Strenuous

Section 5 Gorak Shep to Kala Patar (Optional trek to view sunrise over Everest)	☐ Easy ☐ Quite Difficult ☐ Slightly More Strenuous than expected ☐ Very Strenuous
Section 6 Gorak Shep to Namche Bazaar	☐ Easy ☐ Quite Difficult ☐ Slightly More Strenuous than expected ☐ Very Strenuous
Section 7 Namche Bazaar to Lukla	☐ Easy ☐ Quite Difficult ☐ Slightly More Strenuous than expected ☐ Very Strenuous

Section 3 - Nutrition

Do you normally take any forms of sports drinks, energy gels, energy bars., etc., when undertaking endurance activities?	☐ Never ☐ Occasionally ☐ Most Times ☐ Every Time
On this trip did you feel you needed some additional supplementation?	☐ Never ☐ Occasionally ☐ Most days ☐ Every day

Did you manage to obtain sufficient nutrition from the meals in the tea houses?	☐ Not at all ☐ On some days ☐ On most days ☐ Every day
Was your appetite affected?	☐ Not at all ☐ Sometimes ☐ Most of the time ☐ All of the time
Did the lack of nutrition affect your endurance?	☐ Not at all ☐ Some of the time ☐ Most of the time ☐ All of the time

Section 4 - Mental Fitness

Do you feel that you are a motivated individual?	☐ Not at all ☐ Yes - when undertaking a challenge ☐ Most of the time ☐ All of the time
Do you ever feel sad or depressed for no reason?	☐ Never ☐ Occasionally ☐ Some of the time ☐ All of the time
Do you ever get anxious about work	☐ Never

or life enough to feel ill or that you cannot cope?	☐ Occasionally ☐ More than I like to admit ☐ Often
Does a challenge such as the trip to EBC camp worry you in anyway?	☐ Not at all ☐ A little ☐ Moderately ☐ A great deal
Did you feel unusually low on the trip to EBC?	☐ Not at all ☐ A little ☐ More than usual ☐ Considerably more than usual
Did the low mood affect you on your return home?	☐ Not at all ☐ A little ☐ More than I could understand ☐ To a degree which affected my normal activities
If you were affected, how long did the symptoms last?	☐ Not applicable ☐ < 1 week ☐ 1-2 weeks ☐ 2-3 weeks ☐ 4 or more weeks

Illnesses Experienced

Section 5 - Altitude Sickness

Lake Louise Score (LLS) for the diagnosis of Acute Mountain Sickness (AMS)

Please select any or all of the symptoms and severity levels experienced at any time during the trek.

Headache	No headache	0	
	Mild headache	1	
	Moderate headache	2	
	Severe headache, incapacitating	3	
Gastrointestinal symptoms	None	0	
	Poor appetite or nausea	1	
	Moderate nausea &/or vomiting	2	
	Severe nausea &/or vomiting	3	
Fatigue &/or weakness	Not tired or weak	0	
	Mild fatigue/weakness	1	
	Moderate fatigue/weakness	2	
	Severe fatigue/weakness	3	

Dizziness/light-headedness	Not dizzy	0	
	Mild dizziness	1	
	Moderate dizziness	2	
	Severe dizziness, incapacitating	3	
Difficulty sleeping	Slept as well as usual	0	
	Did not sleep as well as usual	1	
	Woke many times, poor sleep	2	
	Could not sleep at all	3	
	Total Score:		

Section 6 – Altitude Related Symptoms

When did the symptoms first start?	☐ < 3000 metres ☐ 3000 – 3500 metres ☐ 4000 – 4500 metres ☐ 4500-5000 metres ☐ > 5000 metres
When did the symptoms first start?	☐ < 1 day ☐ 1-2 days ☐ 2-3 days☐ > 4 days
Did the symptoms improve on descent?	☐ Yes ☐ No
Did you take Diamox?	☐ Yes ☐ No

If yes, what effect did this have?	☐ Resolved the problem ☐ Improved Breathing ☐ Increased need to drink ☐ Increased/caused diarrhoea ☐ Increased/cause nausea/vomiting ☐ Increased need to urinate
What other medication did you take for altitude?	☐ Paracetamol/Anadin etc. ☐ Stemetil (for nausea) ☐ Imodium/or Nepalese equivalent (diarrhoea) ☐ Antibiotics (if bacterial infection suspected) ☐ Other
Did you take sufficient of your own medication for all eventualities?	☐ Did not take any ☐ Had medication for some symptoms but not all ☐ Needed to request more from the guides ☐ Had sufficient for all symptoms

Section 7 - Bacterial / Viral Infections

Did you suffer from any bacterial / viral infection?	☐ Sickness ☐ Diarrhoea ☐ Other
Did you use an antibacterial hand gel after visiting the toilet and before eating as a minimum?	☐ Not at all ☐ Some of the time ☐ Most of the time ☐ All of the time
How long did it last?	☐ Not applicable ☐ < 1 day ☐ 1-2 days ☐ 3 days or more
Was this type of illness unusual for you	☐ Yes ☐ No
What medication did you take?	☐ Paracetamol/Anadin etc. ☐ Stemetil (for nausea) ☐ Immodium/or similar (diarrhoea) ☐ Antibiotics (if bacterial infection suspected) ☐ Other
Did you have any symptoms on your return home which you felt were not related to jet lag?	☐ Yes ☐ No
If yes, how long did the symptoms last?	☐ Not applicable ☐ < 1 week ☐ 1-2 weeks ☐ 2-3 weeks ☐ 4 or more weeks

Section 8 - Other Illnesses / Feelings

Please tick as many symptoms/items that were relevant to you during the trip.

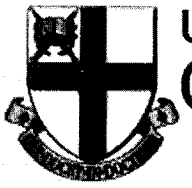
Did you suffer from any other illness?	☐ Respiratory problems – e.g. coughing ☐ Sore throat ☐ Cold/flu type symptoms ☐ Fever ☐ Aches and pains (lower body and or upper body) ☐ Racing heart rate especially at night ☐ Low Mood:- sad, low, tearful, depressed, angry, stressed, anxious, etc.
Did any of these conditions worry you?	☐ Not at all ☐ A little concerning ☐ Was very worrying at the time ☐ Was extremely stressful
Do you feel that it would have been useful to know what other symptoms are commonly experienced at altitude and why?	☐ No ☐ May have been useful ☐ Would have been very useful ☐ Would have prevented unnecessary concern
What did you feel kept you going?	☐ Determination to succeed ☐ Physical Fitness ☐ Mental Stamina ☐ Stubbornness ☐ Morale Support Colleagues ☐ Morale Support guides ☐ Other
What was the worst aspect/s of the trip for you?	☐ Altitude Sickness ☐ Bacterial Infections ☐ Coughing ☐ Cold/Flu symptoms ☐ Feeling low/depressed ☐ Toilets/Hygiene ☐ Food ☐ Disturbed / Lack of Sleep ☐ Cold ☐ Other Please State

What was the best aspect/s of the trip for you?	☐ Achieving your goal ☐ Scenery ☐ People ☐ Physical Exercise ☐ Mental Challenge ☐ Camaraderie ☐ The overall adventure of it all ☐ Other Please State
Do you have a medical condition which impacted on your fitness during the trip?	☐ Yes ☐ No
If yes, please state what this condition is if you are comfortable to do so	
Any other comments / observations you would like to make?	
Would you undertake a similar trip in the future?	☐ Yes ☐ No

Thank you very much for taking the time to complete this questionnaire.

Please mail the questionnaire in the stamped address envelope to the address provided above or email to: [redacted] if you have received the forms electronically.

Appendix 4: FREC B Approval Letter



University of Chester

Faculty of Applied Sciences

Research Ethics Committee

Tel 01244 511740

Fax 01244 511302

frec@chester.ac.uk

4th May 2011

Dear Pamela,

Study title: **The Physical and Psychological Ill effects of trekking to Everest Base Camp.**

FREC reference: 503/11/PG/CS

Version number: 1

Thank you for sending your application to the Faculty of Applied Sciences Research Ethics Committee for review.

I am pleased to confirm ethical approval for the above research, provided that you comply with the conditions set out in the attached document, and adhere to the processes described in your application form and supporting documentation.

he final list of documents reviewed and approved by the Committee is as follows:

Document	Version	Date
Application Form	1	February 2011
Appendix 1 – List of References	1	February 2011
Appendix 2 – C.V. for Lead Researcher	1	February 2011
Appendix 3 – Letter of Invitation (for participants the Lead Researcher met)	1	February 2011
Appendix 4 – Participant Information Sheet	1	February 2011
Appendix 5 – Letter of Invitation (for participants the Lead Researcher did not meet)	1	February 2011
Appendix 6 – Questionnaire	1	February 2011
Appendix 7 – Rationale behind the questions in the Questionnaire	1	February 2011
Response to FREC request for further information and clarification		April 2011
Appendix 4 – Participant Information Sheet	2	April 2011
Appendix 5 – Letter of Invitation (for participants the Lead Researcher did not meet)	2	April 2011
Appendix 6 – Questionnaire	2	April 2011

With the Committee's best wishes for the success of this project.

Yours sincerely,

Simon Alford

Chair, Faculty Research Ethics Committee

Enclosures Standard conditions of approval.

c.c. Supervisor

FREC Representative

Appendix 5: Survey Responses

Weight – by sex and with change

Sex	Number of Responses	Average Weight Before (KG's)	Average Weight After (KG's)	Average Weight Change (KG's)	Range (KG's)
Male	26	76	74	-2	38
Female	22	62	58	-4	33
Incomplete	1	-	-		-
Total	49	70	67	-3	49

Altitude Sickness – LLS Score

LLS Score	Male	Female	No Sex Given
0	2	0	0
1	0	1	0
2	6	1	0
3	2	2	0
4	2	3	0
5	5	3	0
6	1	4	0
7	3	2	0
8	2	3	0
9	2	2	0
10	0	1	0
11	0	1	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
Incomplete	1	0	1

Infection Rate

	Did	Did Not
Bacterial infection (diarrhoea)	21	28

Diamox and Altitude Sickness

	None	Mild	Severe	Total
Did take Diamox	-	4	5	9
Did not take Diamox	9	13	15	37
Incomplete	2	-	1	3
Total	11	17	21	49

Based on Lake Louise Score (3-5 = mild altitude sickness, 6+ = severe altitude sickness)

SECTION 1 – Information on You, Exercise and Training for the Trip

Sex

Answer	Number	%
Male	26	53%
Female	22	45%
Incomplete	1	2%
TOTAL	**49**	**100%**

Age

Answer	Number	%
<21	2	4%
21-30	12	24%
31-40	12	24%
41-50	9	18%
51-60	10	20%

>60	2	4%
Incomplete	2	4%
TOTAL	**49**	**100%**

Height (cm's)

Answer	Number	%
<156	1	2%
156-160	7	14%
161-165	7	14%
166-170	10	20%
171-175	3	6%
176-180	11	22%
>180	5	10%
Incomplete	5	10%
TOTAL	**49**	**100%**

Weight (kg's)

	Before Trek		After Trek	
Answer	**Number**	**%**	**Number**	**%**
<51	1	2%	3	6%
51-55	3	6%	7	14%
56-60	5	10%	4	8%
61-65	10	20%	7	14%

66-70	5	10%	6	12%
71-75	6	12%	8	16%
76-80	7	14%	4	8%
81-85	3	6%	4	8%
86-90	2	4%	0	0%
>90	2	4%	1	2%
Incomplete	5	10%	5	10%
TOTAL	**49**	**100%**	**49**	**100%**

Sessions per week

Answer	Number	%
0	2	4%
1-2	10	20%
2-3	13	26%
3-4	10	20%
4-5	5	10%
5-6	7	14%
6+	1	2%
Incomplete	1	2%
TOTAL	**49**	**100%**

Sessions/time

Answer	Number	%
20 mins	2	4%
40 mins	11	22%
60 mins	14	28%
1-2 hours	14	28%
2 hours plus	6	12%
Incomplete	2	4%
TOTAL	**49**	**100%**

Exercise type

Answer	Number	%
Hill Walking	23	18%
Running	30	23%
Cycling	21	16%
Aerobics	7	5%
Circuits	7	5%
Weights	15	12%
Rowing	5	4%
Yoga	4	3%
Pilates	2	2%
Other	16	12%
TOTAL	**130**	**100%**

Exercise type (number of different selections)

Answer	Number	%
1	11	22%
2	11	22%
3	15	31%
4	6	12%
5	2	4%
6	3	6%
7	0	0%
8	0	0%
9	0	0%
10	0	0%
Incomplete	1	2%
TOTAL	**49**	**100%**

Prior endurance events

Answer	Number	%
Yes	39	80%
No	9	18%
Incomplete	1	2%
TOTAL	**49**	**100%**

Specific Training for the Trip

Answer	Number	%
Yes	34	69%
No	14	29%
Incomplete	1	2%
TOTAL	**49**	**100%**

Specific training type

Answer	Number	%
Hill Walking	26	31%
Running	18	21%
Cycling	9	11%
Step Aerobics	2	2%
Circuits	3	4%
Weights	10	12%
Squats	6	7%
Other	11	13%
TOTAL	**85**	**100%**

Increase/change training

Answer	Number	%
Yes	29	59%
No	18	30%
Incomplete	2	4%
TOTAL	**49**	**100%**

Additional Vitamins/Minerals/Medications to Help with Altitude

Answer	Number	%
Gingko Biloba	2	10%
Altivit	2	10%
Garlic	3	14%
Diamox	7	33%
Other	7	33%
TOTAL	**21**	**100%**

How strenuous did you find the trek?

Answer	Number	%
Less than expected	18	37%
As expected	19	39%
Slightly more than expected	7	14%
Very strenuous	4	8%
Incomplete	1	2%
TOTAL	**49**	**100%**

Did your heart rise above expected level?

Answer	Number	%
No	23	47%
A Little	13	27%
More than I would have expected	9	18%
Considerably more than I would have expected	4	8%
Incomplete	0	0%
TOTAL	**49**	**100%**

Heart rate increase at night

Answer	Number	%
Not at all	14	29%
A little	20	41%
On several nights	12	24%
It felt high almost every night	2	4%
Incomplete	1	2%
TOTAL	**49**	**100%**

SECTION 2 – How Difficult was Each Section of the Trek

How difficult was each section of the trek

Trekking Section	Easy	Quite Difficult	More Strenuous than Expected	Very Strenuous	Incomplete	TOTAL
1 - Lukla to Namche Bazaar	28	11	6	4	0	**49**
2 – Namche Bazaar to Pangboche Monastery	18	20	6	1	4	**49**
3 – Pangboche to Gorek Shep	9	24	11	2	3	**49**
4 – Gorek Shep to EBC	6	22	9	10	2	**49**
5 – Gorek Shep to Kala Patar (optional)	4	8	3	17	17	**49**
6 – Gorek Shep to Namche Bazaar	29	14	3	2	1	**49**
7 – Namche Bazaar to Lukla	33	12	4	0	0	**49**
TOTAL	**127**	**111**	**42**	**36**	**27**	**343**

Normally take sports drinks/energy gels etc when undertaking endurance activities

Answer	Number	%
Never	17	35%
Occasionally	19	39%
Most Times	7	14%
Every Time	4	8%
Incomplete	2	4%
TOTAL	**49**	**100%**

Needed additional supplementation

Answer	Number	%
Never	11	22%
Occasionally	25	51%
Most Days	7	14%
Every Day	4	8%
Incomplete	2	4%
TOTAL	**49**	**100%**

Sufficient nutrition from the meals in the tea houses

Answer	Number	%
Not at all	8	16%
On some days	16	33%
On most days	12	24%
Every day	11	22%
Incomplete	2	4%
TOTAL	**49**	**100%**

Appetite affected

Answer	Number	%
Not at all	14	29%
Sometimes	22	45%
Most of the time	9	18%
All of the time	2	4%
Incomplete	2	4%
TOTAL	**49**	**100%**

Lack of nutrition affected your endurance

Answer	Number	%
Not at all	24	49%
Some of the time	11	22%
Most of the time	7	14%
All of the time	4	8%
Incomplete	3	6%
TOTAL	**49**	**100%**

SECTION 4 – Mental Fitness

Do you feel that you are a motivated individual?

Answer	Number	%
Not at all	2	4%
Yes – When undertaking a challenge	8	16%
Most of the time	17	35%
All of the time	20	41%
Incomplete	2	4%
TOTAL	**49**	**100%**

Do you ever feel sad or depressed for no reason?

Answer	Number	%
Never	23	47%
Occasionally	20	41%
Some of the time	4	8%
All of the time	0	0%
Incomplete	2	4%
TOTAL	**49**	**100%**

Do you ever get anxious about work or life enough to feel ill or that you cannot cope?

Answer	Number	%
Never	32	65%
Occasionally	13	27%
More than I like to admit	1	2%
Often	1	2%
Incomplete	2	4%
TOTAL	**49**	**100%**

Does a challenge such as the trip to EBC worry you in anyway?

Answer	Number	%
Not at all	23	47%
A little	21	43%
Moderately	3	6%
A great deal	0	0%
Incomplete	2	4%
TOTAL	**49**	**100%**

Did you feel unusually low on the trip to EBC?

Answer	Number	%
Not at all	31	63%
A little	11	22%
More than usual	4	8%
Considerably more than usual	1	2%
Incomplete	2	4%
TOTAL	**49**	**100%**

Did the low mood affect you on your return home?

Answer	Number	%
Not at all	35	71%
A little	4	8%
More than I could understand	4	8%
To a degree which affected my normal activities	0	0%
Incomplete	6	12%
TOTAL	**49**	**100%**

If you were affected, how long did the symptoms last?

Answer	Number	%
Not applicable	34	69%
<1 week	3	6%
1-2 weeks	1	2%
2-3 weeks	3	6%
4 or more weeks	2	4%
Incomplete	6	12%
TOTAL	**49**	**100%**

SECTION 5 – Altitude Sickness

Headache

Answer	Number	%
No Headache	7	14%
Mild headache	19	39%
Moderate headache	14	29%
Severe headache	7	14%
Incomplete	2	4%
TOTAL	**49**	**100%**

Gastrointestinal Symptoms

Answer	Number	%
None	19	39%
Poor appetite or nausea	21	43%
Moderate nausea &/or vomiting	5	10%
Severe nausea &/or vomiting	2	4%
Incomplete	2	4%
TOTAL	**49**	**100%**

Fatigue &/or weakness

Answer	Number	%
Not tired or weak	13	26%
Mild fatigue/weakness	18	39%
Moderate fatigue/weakness	13	26%
Severe fatigue/weakness	4	8%
Incomplete	1	2%
TOTAL	**49**	**100%**

Dizziness/light-headedness

Answer	Number	%
Not dizzy	27	55%
Mild dizziness	11	22%
Moderate dizziness	8	16%
Severe dizziness, incapacitating	0	0%
Incomplete	3	6%
TOTAL	**49**	**100%**

Difficulty Sleeping

Answer	Number	%
Slept as well as usual	11	22%
Did not sleep as well as usual	18	37%
Woke many times, poor sleep	15	31%
Could not sleep at all	4	8%
Incomplete	1	2%
TOTAL	**49**	**100%**

SECTION 6 – Altitude Related Symptoms

When did the symptoms start?

Answer	Number	%
<3000 metres	1	2%
3000-3500 metres	8	16%
4000-4500 metres	21	43%
4500-5000 metres	9	18%
>5000 metres	5	10%
Incomplete	5	10%
TOTAL	**49**	**100%**

When did the symptoms start?

Answer	Number	%
<1 day	1	2%
1-2 days	4	8%
2-3 days	8	16%
>4 days	29	59%
Incomplete	7	14%
TOTAL	**49**	**100%**

Did the symptoms improve on descent?

Answer	Number	%
Yes	41	84%
No	2	4%
Incomplete	6	12%
TOTAL	**49**	**100%**

Did you take Diamox?

Answer	Number	%
Yes	8	16%
No	37	76%%
Incomplete	4	8%
TOTAL	**49**	**100%**

If yes, what effect did this have?

Answer	Number	%
Resolved the problem	3	27%
Improved breathing	3	27%
Increased need to drink	2	18%
Increased diarrhoea	0	0%
Increased nausea/vomiting	0	0%
Increased need to urine	3	27%
TOTAL	**11**	**100%**

What other medication did you take for altitude?

Answer	Number	%
Paracetamol	33	65%
Stemetil	3	6%
Imodium or Nepalese equivalent	8	16%
Antibiotics	5	10%
Other	2	4%
TOTAL	**51**	**100%**

Did you take sufficient medication for all eventualities?

Answer	Number	%
Did not take any	9	18%
Had medication for some symptoms but not all	14	29%
Needed to request more from the guides	3	6%
Had sufficient for all symptoms	22	45%
Incomplete	1	2%
TOTAL	**49**	**100%**

SECTION 7 – Bacterial/Viral Infections

Did you suffer from any bacterial/viral infection?

Answer	Number	%
Sickness	5	9%
Diarrhoea	21	40%
Other	4	8%
No Answer	23	43%
TOTAL	**53**	**100%**

Did you use an antibacterial hand gel after visiting the toilet and before eating as a minimum?

Answer	Number	%
Not at all	1	2%
Some of the time	9	18%
Most of the time	7	14%
All of the time	32	65%
Incomplete	0	0%
TOTAL	**49**	**100%**

How long did it last?

Answer	Number	%
Not applicable	20	41%
<1 day	2	4%
1-2 days	6	12%
3 days or more	17	35%
Incomplete	4	8%
TOTAL	**49**	**100%**

Was this type of illness unusual for you?

Answer	Number	%
Yes	18	37%
No	8	16%
Incomplete	23	47%
TOTAL	**49**	**100%**

What medication did you take?

Answer	Number	%
Paracetamol/Anadin	14	34%
Stemetil	3	7%
Imodium or similar	15	37%
Antibiotics	6	15%
Other	3	6%
TOTAL	**41**	**100%**

(41 answers from 28 people who supplied answers)

Did you have any symptoms on your return home which you felt were not related to jet lag?

Answer	Number	%
Yes	30	61%
No	18	37%
Incomplete	1	2%
TOTAL	**49**	**100%**

If yes, how long did the symptoms last?

Answer	Number	%
Not applicable	24	49%
<1 week	3	6%
1-2 weeks	4	8%
2-3 weeks	6	12%
4 or more weeks	5	10%
Incomplete	7	14%
TOTAL	**49**	**100%**

SECTION 8 – Other Illnesses/Feelings

Did you suffer from any other illness?

Answer	Number	%
Respiratory Problems	15	21%
Sore throat	14	19%
Cold/flu type symptoms	11	15%
Fever	1	1%
Aches and pains	9	13%
Racing heart rate	12	17%
Low Mood	10	14%
TOTAL	**72**	**100%**

(72 answers from 38 people who supplied answers)

Did any of these conditions worry you?

Answer	Number	%
Not at all	23	27%
A little concerning	15	31%
Was very worrying at the time	3	6%
Was extremely stressful	0	0%
Incomplete	8	16%
TOTAL	**49**	**100%**

Do you feel that it would have been useful to know what other symptoms are commonly experienced at altitude and why?

Answer	Number	%
No	8	16%
May have been useful	19	29%
Would have been very useful	8	16%
Would have prevented unnecessary concern	1	2%
Incomplete	13	27%
TOTAL	**49**	**100%**

Do you feel that it would have been useful to know what other symptoms are commonly experienced at altitude and why?

Answer	Number	%
No	8	16%
May have been useful	19	29%
Would have been very useful	8	16%
Would have prevented unnecessary concern	1	2%
Incomplete	13	27%
TOTAL	**49**	**100%**

What did you feel kept you going?

Answer	Number	%
Determination to succeed	36	73%
Physical fitness	30	61%
Mental stamina	27	54%
Stubbornness	12	24%
Morale support colleagues	24	49%
Morale support guides	19	38%
Other	3	6%
TOTAL	**151**	

What was the worst aspect of the trip for you?

Answer	Number	%
Altitude sickness	10	11%
Bacterial infections	7	8%
Coughing	7	8%
Cold/flu symptoms	2	2%
Feeling low/depressed	1	1%
Toilets/hygiene	22	25%
Food	10	11%
Disturbed/lack of sleep	9	10%
Cold	13	15%
Other	6	7%
TOTAL	**87**	

(87 responses from 44 people who supplied answers)

What was the worst aspect of the trip for you?

Answer	Number	%
Altitude sickness	10	11%
Bacterial infections	7	8%
Coughing	7	8%
Cold/flu symptoms	2	2%
Feeling low/depressed	1	1%
Toilets/hygiene	22	25%
Food	10	11%

Disturbed/lack of sleep	9	10%
Cold	13	15%
Other	6	7%
TOTAL	**87**	

(87 responses from 44 people who supplied answers)

What was the best aspect of the trip for you?

Answer	Number	%
Achieving your goal	37	15%
Scenery	42	18%
People	37	15%
Physical exercise	28	12%
Mental challenge	28	12%
Camaraderie	26	11%
The overall adventure of it all	38	16%
Other	3	1%
TOTAL	**239**	

(239 responses from 47 people who supplied answers)

Do you have a medical condition which impacted on your fitness during the trip?

Answer	Number	%
Yes	5	10%
No	42	84%
Incomplete	2	6%
TOTAL	**49**	**100%**

If yes, please state what this condition is if you are comfortable to do so?

Asthma x 3

Very weak at top

Would you undertake a similar trip in the future?

Answer	Number	%
Yes	44	90%
No	3	6%
Incomplete	2	4%
TOTAL	**49**	**100%**